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A Large Screw Machine.

The cut accompanying this represents what is said to be the largest complete screw machine yet built. It is adapted for the heaviest work in locomotive, stationary and marine engine shops.

It is calculated for finished work up to 2¼″ diameter, and will take stock up to 3¼″ diameter. It will cut screws with dies in the turret up to 2¼″ in diameter, and will cut threads with the chasing bar up to 3¼″ in diameter.

The spindle is provided with back gears, which are applied by a clutch operated without stopping the machine. The cut-off rest has a longitudinal feed on the bed, and may be used for turning like the carriage of a lathe. The cross slide has compound motions, and is operated by a screw.

Each machine is provided with clutch, back gears, chasing apparatus, self-acting feed for milling, and longitudinal feed for the cut-off rest, a countershaft with friction pulleys, a chuck, a face plate, three change gears for the feed, suitable wrenches, a box tool, bushings for the turret holes, chuck for the back end of spindle, a die-holder, and a stop-gauge. When made with chasing apparatus, one hob (including leader, follower, and cutter) is furnished.

Some of the dimensions are as follows: Length of bed, 8′ 6″; swing over bed, 24″; weight, 6,200 lbs.; hole in spindle, 3¼″ diameter; six holes in turret, 3 7/16″ diameter; diameter of turret 16½″; length it can mill, 14½″; diameter of spindle cones, 9, 12, and 15″, and 5″ face; large bearing, 6″ long, 4⅛″ diameter; small bearing, 4½″ long, 4″ diameter; size of countershaft pulleys, 18″ diameter, 5½″ face; speed, 100 revoutions per minute.

This machine is built by The Jones & Lamson Machine Company, Windsor, Vt.; the general selling agents are Hill, Clarke & Co., Boston, Mass.

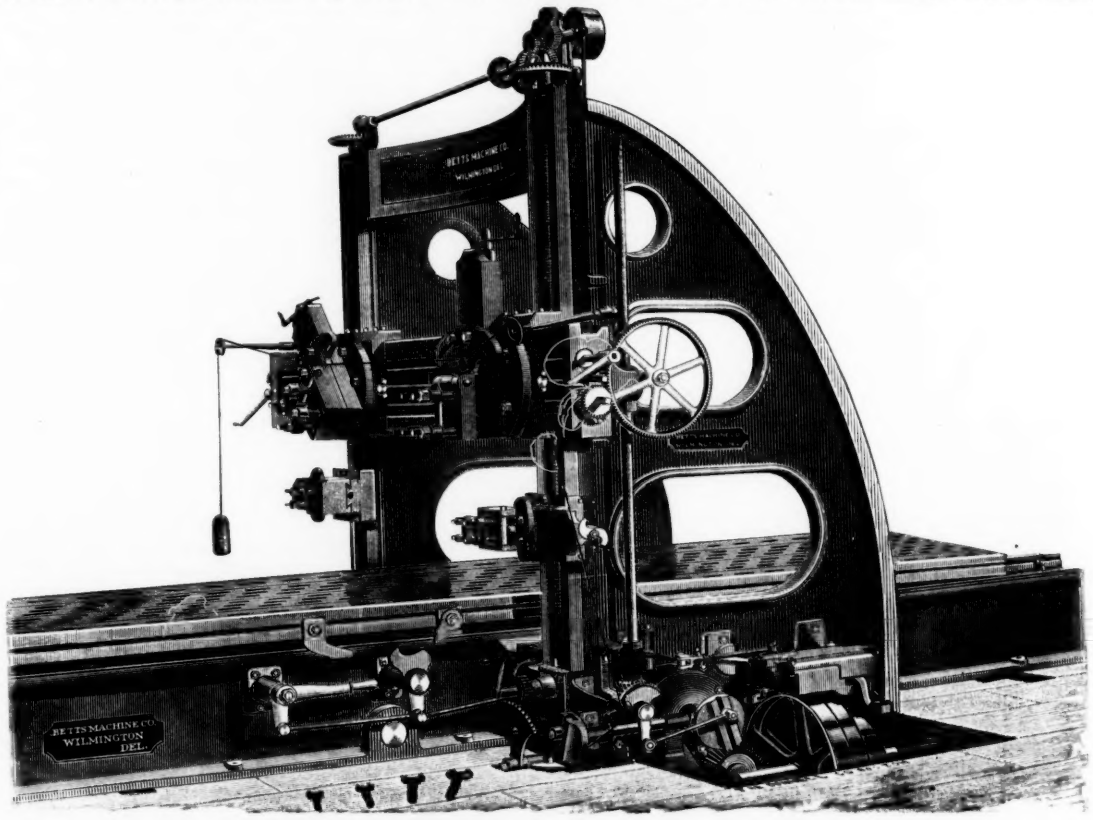
A correspondent has trouble with hard wood that in the manufacture is saturated with oil, and afterwards finished with shellac. After finishing, the oil comes through, even after drying. He would like to know of some remedy.

Six-Foot Planing Machine.

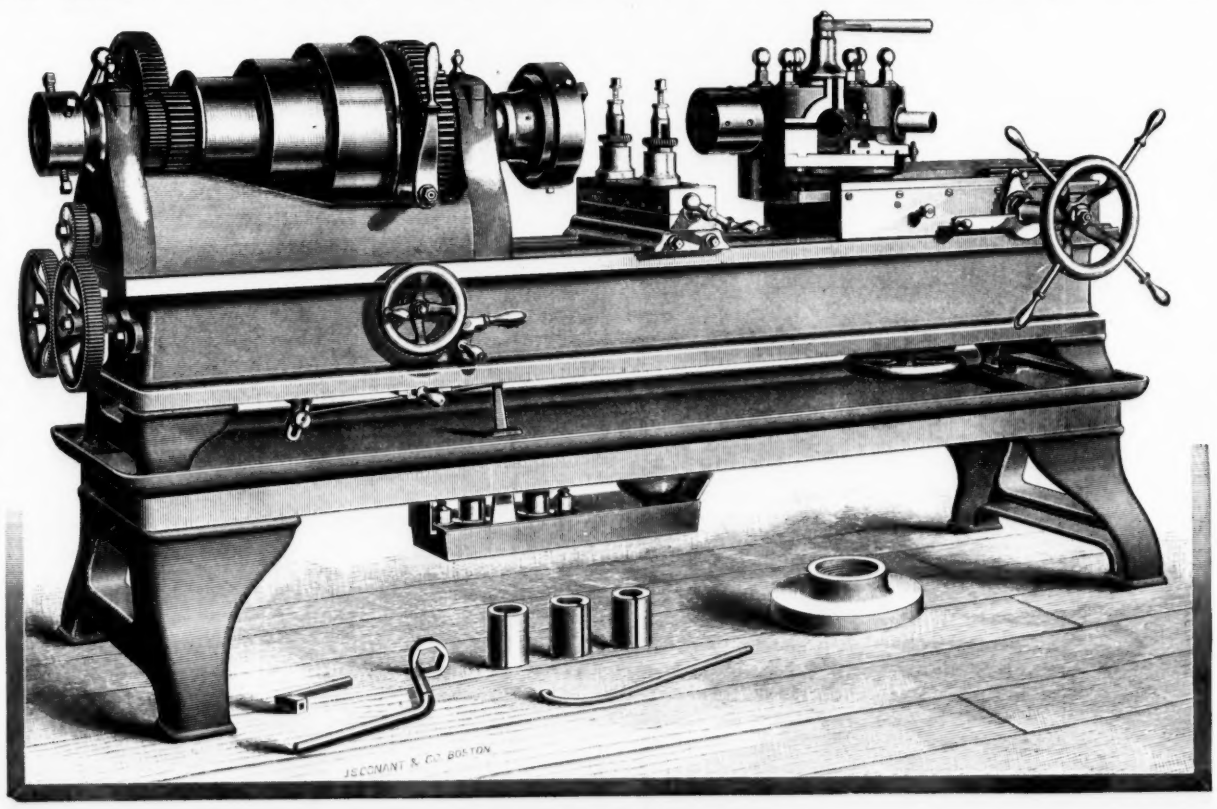
The cut herewith represents the improved six-foot planer as made by the Betts Machine Company, Wilmington, Del. The machine was designed for strength and rigidity, convenience and rapidity in manipulation, and accuracy in the work performed. It is powerfully geared, having a belt speed of 124 feet to one foot of table. The driving shafts are of unusual strength; the gearing is all cut, and the pinions are of wrought-iron. To prevent the wear and tear on belts, and to do away with the usual squeaking noise, the shifters are made to throw one belt ahead of the other. The arrangement of shifter levers is such that the workman has complete control of the machine from either side. There are feed motions on both sides of the machine, giving independent feeds to the saddles and side heads. The cross rail is designed for the heaviest class of work, and can be raised and lowered by power.

By a device for disengaging the up and down slides in the saddle, either or both of the slides can be used at pleasure.

The machine here shown has four tools, two on the cross-rail, and one on each upright. It can be arranged with one or more tools, depending on the class of work for which it is intended.



SIX FOOT PLANING MACHINE.



LARGE SCREW MACHINE.

The report of the treasurer of the American Bell Telephone Company, submitted at the recent annual meeting of stockholders at Boston, shows a very satisfactory state of affairs (from the standpoint of the company). The gross earnings for the year were $3,453,027.70, and expenses $1,242,430.89, making the net earnings for the year $2,210,596.81. The dividends paid on the capital stock during the year amounted to 16 per cent.

This showing, when taken in connection with the probability that a large proportion of the capital stock is water put in to reduce the enormous dividends to something like a reasonable percentage, and represents no investment of capital whatever, and with the fact that the company has recently been at the enormous expense of a strongly contested but successful suit in the Supreme Court, is a good illustration of the way the public is charged exorbitant rates for service in which there is no possibility of competition.

There are many thousand buildings in the city of New York unprovided with fire escapes, as called for by plain provisions of law. This fact comes up every few months, when some one is burned to death in one of these traps, or when two or three firemen are killed or injured in assisting imprisoned inmates to escape from the upper stories of burning buildings. The city makes pretense of seeing that the ordinance calling for fire escapes is complied with, and hence ought to be held pecuniarily responsible for accident in cases where it permits the law to be set at naught. It would be an excellent thing to look after the fire escapes, even if to do so necessitated letting up on the corner peanut vender.

Compound Engines.

By W. H. Booth.

Fourth Paper.

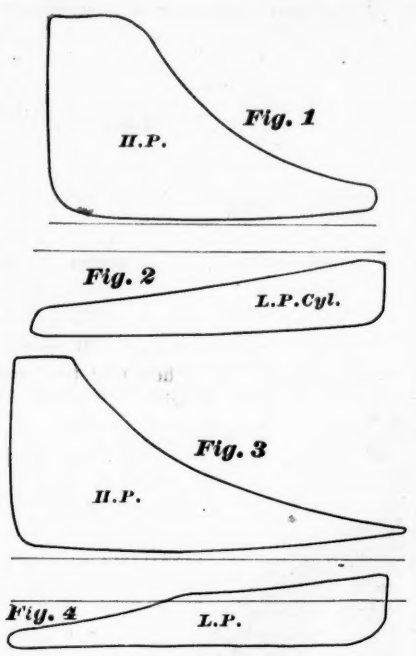
A question considered in a previous article brings forward a faulty bit of design often met with in the compound engine, and clearly due to a misconception on the part of the designer. I allude to the exceeding smallness of the low pressure valves and ports. It would appear that the small cylinder and its valve had first been designed, and that the larger valve of the low pressure cylinder had next been made but little greater, with the idea, apparently, that the steam which has passed through the high pressure valve will as easily pass through a low pressure valve of equal size. This quite ignores the fact that both moisture and low pressure diminish the volume of steam passing through an orifice in a unit of time. Hence the admission port of the second cylinder of a compound engine requires to be of greater area than in an equal sized cylinder of a simple engine.

Many engineers altogether refuse to believe in the benefit arising from the use of the intermediate receiver. Probably this arises from the fact that receivers have been too large or too small. A good volume for a receiver is that of the high pressure cylinder. When this volume is selected, a fairly early cut-off may take place in the larger cylinder without causing undue compression in the small cylinder. With too large a receiver the surfaces radiating heat are large, and loss results, but otherwise a large receiver is not an evil. In compound engines the low pressure admission requires to be cut off sufficiently early to cause the pressure in the receiver to be maintained at the proper amount consistent with the rate of expansion. When this is not maintained there is a heavy drop of pressure between the two cylinders, as shown in Figs. 1 and 2.*

By cutting off earlier in the second cylinder, this drop is avoided, and the initial pressure in the large cylinder is raised, whilst the back pressure on the small piston is also increased, but to a less extent, and the net result is a gain, and diagrams similar to Figs. 3 and 4 will be obtained, where the initial pressure in the second cylinder is quite close up to the final in the high pressure.

Apart from the economic value of a cut-off in the large cylinder, advantage may be taken of this power to regulate, if thought fit, the relative amount of work performed in the two cylinders, the cutting off in the large cylinder and consequent rise in its initial pressure, together with the increase in the resistance thus opposed to the motion of the small piston, serving to reduce the power developed by the latter. In faulty designs it is almost invariably that we find the lion's share of the work to be done in the small cylinder, which frequently drags the large piston round with it, this last being rather an incumbrance than otherwise. Hence, when a great disproportion of power is found between the two cylinders, it is usually a wise step to correct this disproportion by effecting an earlier cut-off in the second cylinder. Doubtless there are occasions when this cannot with advantage be carried out, by reason of cramped steam passages or short valve chest, but we may well doubt the expediency of continuing the life of a cylinder so badly designed as to demand to be left alone, and question whether it would not pay to replace it with a new one of more liberal and comprehensive design.

Very striking results may sometimes be effected with slight alterations, and two illustrations may be given. A celebrated firm of engine builders supplied engines to two cotton mills. They were plain compound engines, from the same patterns, and had about an equal amount of work to perform. The cylinders were 30 inches, and 47 inches in diameter, and were set parallel one with the other on separate beds, and turned each its own crank. In both cases, as might have been anticipated from the smallness of the low pressure cylinder, the engines were found too small for their load. To remedy this, in the one instance first taken in hand, both cylinders were removed, and the engine was converted, at a heavy cost, into a pair of tandems, with two 21-inch small cylinders, and



Compound Engines.

two 38-inch large cylinders, or the equivalent of an ordinary compound engine with one 29¾-inch cylinder, and one 54-inch cylinder. The alteration necessitated the lengthening of the bed, and a stoppage of six weeks.

In the second case the alteration necessary was effected simply by removal of the large cylinder, and its substitution by a new one of 55 inches diameter, at comparatively small cost, and with but a short stoppage of a few days only. The result was better than that obtained by the tandem type, and in every way more satisfactory. The cause of the different counsels prevailing was that in the first case the engine builder was consulted, and made a job to suit his pocket, whilst in the second case the advice of an independent engineer carried sway. It is curious to note that in the original engine the joint area of the high and low pressure cylinders is almost exactly that of the finally adopted large cylinder, and would almost appear to indicate that the idea of the constructors was that the power of a compound engine was that of its two cylinders, and not, as is the fact, of the last cylinder alone, as already pointed out. This is a fallacy which is too commonly held as a truth, but very mischievous in its results, and, indeed, in its outcome, either by intentional design or otherwise, responsible for very much of the worst practice in compound engines.

* These figures are not actual diagrams, but simply sketches similar to diagrams taken by the writer, but not available.

Foundry Cupolas.

By Robert E. Masters.

In this issue are shown two of the more modern styles of cupolas. At Fig. 1 are two views of a cupola, having two rows of tuyeres. The right hand section shows how the air chamber *A*, which extends all the way around the cupola, arches over the breast hole and cupola spout *B B*. Opposite this, in the rear of the cupola, there is a similar archway over the slag hole and spout. The left hand illustration is a sectional view of the cupola halfway between the breast and slag holes.

The lower tuyeres *C C* are oblong, and are located higher from the bottom plate than any other cupola that I know of in use at the present day. The upper row of tuyeres *D D* are round, and they are situated about 12″ above, and on a line drawn halfway between the lower ones; there are inside slides to the tuyeres intended to diminish the blast if necessary, but they are not so convenient to get at as a valve in the blast pipe, which is by far the quickest and best method of regulating the blast in any cupola, if it is coming too strong, especially if there is other machinery operated by the engine or water wheel that runs the cupola fan.

The upper row of tuyeres have a set of valves or slides connected together by rods, and are operated by an auger-like handle on the outside of the air chamber. These tuyeres are to be kept closed until the melted iron appears; they are then opened, and not closed again until the last charge of iron settles down within two feet of them. The above in regard to the upper row of tuyeres is, in substance, part of the instructions that come with the cupola.

What is claimed for the upper tuyeres is the oxygen supplied through them ignites the carbonic oxide, which is generated by the action of the lower tuyeres, and prevents the loss of this heat, which is always seen to ignite at the charging door of a cupola, with one row of tuyeres, and which nearly roasts the men who are charging the cupola, especially in the southern country, where they have scarcely any cold weather. One thing can be said of this cupola (even if it possesses no other advantages), it is the most comfortable cupola to charge on a hot summer day that I have ever had in operation.

The report of the working of this cupola, given below, was kindly sent to me by Mr. Henry Ensign, foreman of car wheel foundry:

Huntington, West Va., Aug. 2, 1887.

MELTING IN THE ENSIGN M'F'G CO'S CAR WHEEL FOUNDRY.

Style of cupola	Collian.
Outside diameter	62″
Thickness of lining	7″
Inside diameter at tuyeres	48″
Largest inside or melting point diam.	48″
Inside diam. at charging door	48″
Height from bottom plate up to bottom of charging door	14′
Lower tuyeres, six oblong	4″×8″
Upper tuyeres, six round	2½″
Height from bottom plate to bottom of tuyere	24″
Height of tuyere above sand bottom on back side	21″
Height from bottom plate to bottom of slag hole	18″
Size and name of blower	Sturtevant No. 9.
Size and length of blast pipe, 14″ diam. 15′ long.	

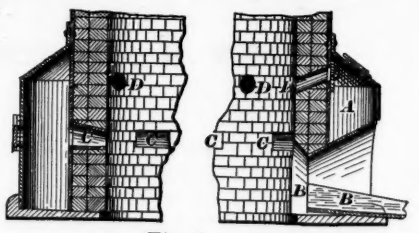


Fig. 1

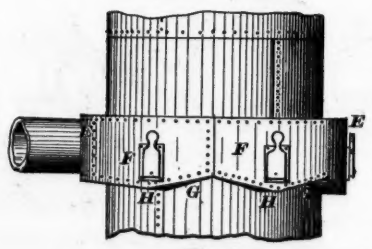


Fig. 2

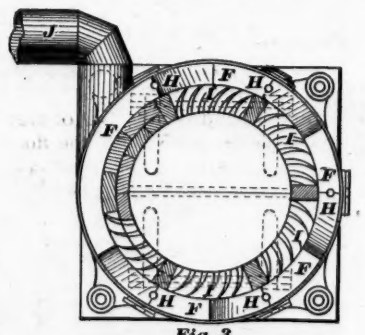


Fig. 3
Foundry Cupola

MODE OF CHARGING CUPOLA.

Fuel used for bed	Coke 1,700 lbs.
1st charge of iron	
	Scrap 1,200 lbs. Pig 2,160 lbs.
1st charge of fuel	Coke 350 lbs.
2d charge of iron	
	Scrap 1,200 lbs. Pig 2,160 lbs.

Twenty-two and a half charges were added to the above, the same as stated in the last charge.

MODE OF WORKING CUPOLA.

Time of starting fire	10.10 o'clock A. M
Time of charging first iron	10.40 " A. M.
Blast put on	11.10 " A. M.
First appearance fluid iron	11.55 " A. M.
Bottom dropped	4.50 " P. M.
Revolutions or stroke of blower	1,800
Pressure of blast	5½ oz.
Kind of fuel used	New River Coke.
Quality of fuel	Good.
Kind of flux used	Limestone.

TOTALS.

Amount of iron melted	82,300 lbs.
Amount of fuel consumed	9,700 lbs.
Ratio of fuel to iron used	1 to 8.48/100

The inside diameter being the same at the points given, is accounted for by the fact that the cupola had been relined a short time previous.

Fig. 3 is a cross-section of Fig. 2 from *E E*, showing the air chamber *F F*, which belts the cupola. The inclines *G G* at the bottom of the air chamber are for the purpose of allowing any metal which may enter the air chamber to escape through the holes *H H*. These holes are closed with lead plugs. Foundrymen who have had overflows in their cupola, and have had a time to get the metal out of the tuyeres and air chamber, will appreciate this point.

The tuyere irons are cast in upper and lower segments, with the curved chutes *I I* cast on the lower plates. These segments are fitted together and placed in the cupola with the chutes inclined toward the direction from which the blast comes through the pipe *J*. This is intended, according to the manufacturers, "to arrest the circular motion of the blast and direct it to the center of the cupola."

The result of a heat in this cupola is given as follows by E. D. Plaisted, foreman:

Springfield, Ohio, Oct. 28, 1887.

Style of cupola	Blakeney.
Outside diameter	70″
Thickness of lining	7″
Inside diameter at all points	56″
Height of bottom plate up to bottom of charging door	13″
Style of cupola	Curved chutes.
Size of tuyeres	⅞″ × 3½″
Number of tuyeres	Continuous, except 2′ at the back of cupola.
Height from bottom plate to bottom of tuyere	18″
Height of tuyere above sand bottom on back side	12″
Height from bottom plate to bottom of slag hole	17″
Size and name of blower	Sturtevant, No. 7.
Size and length of blast pipe,	16″ dia. 21′ long.

MODE OF CHARGING CUPOLA.

Fuel for bed	Coke, 1,100.
1st charge of iron	
	Scrap, 1,800 lbs. Pig, 3,600 lbs.
1st charge of fuel	Coke, 200 lbs.
2d charge of iron	
	Scrap, 600 lbs. Pig, 600 lbs.
Ten more charges same as this last charge.	
12th charge of fuel	Coke, 120 lbs.
13th charge of iron	
	Scrap, 600 lbs Pig, 600 lbs.
This was repeated for four more charges.	
17th charge of iron	
	Scrap, 10,800 lbs. Pig, none.
No coke was used with this scrap iron.	

MODE OF WORKING CUPOLA.

Time of starting fire	2.45 o'clock P. M.
Blast put on	4.00 " "
First appearance fluid iron	4.10 " "
Bottom dropped	6.00 " "
Revolutions or stroke of blower	2,500
Quality of fuel	72 hour Connellsville coke.
Kind of flux used	Limestone.
Quantity of flux per ton of iron,	60 to 75 lbs.

TOTALS.

Amount of iron melted	35,400 lbs.
Amount of fuel consumed	3,900 "
Ratio of fuel to iron used	1 to 9 7/10
Fluidity of melted iron,	Suitable for light castings.

Remarks.—Cupola is charged full up to charging door before lighting fire.

The remarks on charging the cupola by Mr. Plaisted will be a new idea to many foundrymen, and the amount of scrap in the seventeenth charge, at the last of the heat, without any fuel used in connection with it, will no doubt seem excessive to the readers of this article, as it did to me; but in a correspondence on the workings of this cupola, Mr. Steele, a member of the firm, assures me they are willing to make affidavit to the correctness of the above report.

Vertical Drills—Their Construction and Uses.

By John J. Grant.

Radial drills, like any other machine tool, are made in various forms and modifications, according to ideas and whims of the designer or maker. Also, like any other tool, there can be but one proper form for strength and stiffness. There may be many different arrangements of parts and various forms of driving and feeding mechanism, each equally as good and handy to use. They may also be made more or less intricate, as in the plain radial drill with its arm adjustable vertically, radially, and horizontally, or the more elaborate universal radial drill, having all the above adjustments, and in addition the drill head made to swivel on the sliding saddle and the arm to revolve around the driving shaft, so that holes may be drilled at any possible angle. All of the various kinds have their places, also their good and their bad points.

All radial drills have one defect which can never be entirely overcome, that is, the upward spring of the arm especially when the drill head is at the extreme end. One make, at least, has a radial slot in the base, and a post that is made to bolt to the end of the arm, and also to the base; this is all right, but is often in the way and has to be removed entirely; it also has the disadvantage of having to be adjusted for every upward or radial movement of the arm. Much of the spring of a radial drill can be overcome by a judicious and correct distribution of metal.

There is also a torsional strain on the arm, caused by the drill spindle being placed on one side; this has been overcome by some makers, who place the spindle in the center of the arm. This arrangement accomplishes what it is intended to do, but has the disadvantage that the head cannot be swiveled, and the feed motions are not as handy.

The drill spindle should be as nearly balanced as possible. This has been done in many ways, some good and others bad. I would suggest that it be done as in the sketch *A*, Fig. 1. That is, with a weight in the shape of an auxiliary spindle, having a pinion engaging the rack cut in the drill spindle sleeve with the one cut in the balance spindle. The pinion should not be the one used to feed the spindle, but an extra one, as the "back lash" will then be taken up on the sleeve, when the drill comes through the work. A universal radial drill spindle would be balanced in this manner, no matter what position the spindle might be put into, which is not the case with most of the arrangements in use at present.

The arrangement of driving power for any form of radial drill is a study, it being a difficult thing to carry power to a spindle, especially if the spindle be made to adjust in all positions. One or two makers have brought the belt power directly to the spindle, the belt passing around a pulley, having the back gearing placed where it will do the most good.

In the Whitworth radial drill the driving shaft has a bevel gear engaging with one on the spindle direct; this makes it necessary to use a telescopic shaft, the inner one having a feather key, and the outer one a spline. It would seem that this arrangement was weak, but those who have had these drills in use for several years say that there has been no trouble from it.

Many radial drills have the upright or column made round and turned to receive the arm, which is bored out to fit. In my judgment this is very faulty. Others are made without any adjustment vertically. When made for a special job this may be all right, but they are not good for general work. Most radial drills are fairly rigid when the arm is in line with the base, and radial drills are seldom used for more than 180° of the circle around the column. What objection is there to making the column two or three times as wide at the bottom as at the top, and in this way secure nearly the same stiffness when the arm is at right angles to the base as when in a line with it? There are, of course, some who would object to this as not satisfying to the eye, for instance:

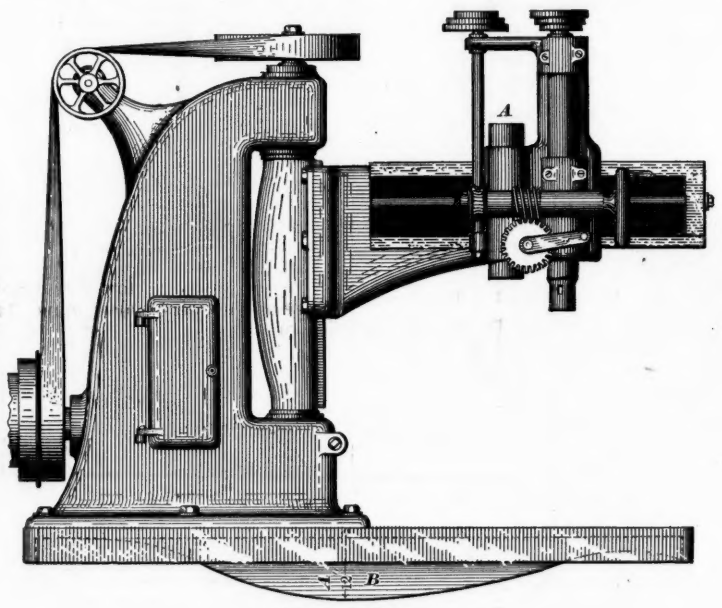
"Grumbler," who in your issue of Dec. 31st, says: "I don't think I should want any such clumsy looking tool as the picture is, Fig. 2." Now, I believe that "there's beauty in the bellow of the blast, and grandeur in the blowing of the gale;" and also that beauty in form should never be the first consideration in designing machine tools. My idea is that first there should be strength; second, power enough to do all that will be required of the tool; third, ease of manipulation; fourth, beauty, or rather symmetry. It will be easy for the designer, if a good one, to get any machine into a good-looking dress, although what would please one would be distasteful to another. This is simply a matter of education of the eye. Who has not noticed the improvements in planers for the last few years, and watched the development of the upright or post from a miserable little narrow base, not more than one-quarter of the height to one three-quarters. The result has been a far better tool.

To return to the radial drill, does not this same rule hold good in this tool? I have seen drills made within the last five years which would be unsafe to leave with the power feed on until the drill point came through the work, as the great amount of spring in the column and base would shoot the drill through and break it.

The base is seldom made one-half deep enough. Notice the difference in the depth of the two bases shown in your issue of Dec. 3d. Where the drill is to be used on the ground floor, making it possible to put in a foundation, it is well to supplement the regular ribbing with ribs of the shape shown in the sketch *B*, Fig. 1, which at *A* should not be less than 12″ deep, and 1½″ thick. There should be three or four of them when the drills are to be used on upper floors. The floor could be cut away in most cases, to let them through. When it is not possible to have them made in this way, the base for a four foot arm drill should not be less than eight inches deep, and the metal put in the best possible form for strength.

In setting radial drills the top of the base should always be level with the floor. A square or rectangular box planed perfectly true on all sides, and with T-slots for bolting work on, is a necessity, as the arm of a radial drill seldom comes down to within two feet of the floor.

The advantage of the radial drill over other drills described is that, with one setting, a piece of work can be drilled on any part of the top surface, be it as large as the sweep of the radial arm, and with the swiveling head and arm work can often be drilled on all sides, and at various angles.



Vertical Drills.

A correspondent of the *Ironmonger* (London), while evidently trying to favor Russian petroleum, confesses, in regard to the Russian product, that "the odor is very disagreeable, and that it causes the lamp to smoke much more quickly than the American."

Design, Construction, Repairs and Management of Marine Steam Engines and Boilers.

By W. H. Hoffman.

THIRD PAPER.

In my second paper on this subject, I gave proportions for the journals of a crank-shaft for a triple expansion engine of 3,300 horse-power, calculated from an initial gauge pressure of 160 pounds per square inch, the steam expanding in cylinders 26″ — 40″ — 68″ × 54″ after being cut-off at $\frac{6}{10}$ of the stroke in the high pressure cylinder. Revolutions from 80 to 84 per minute. Screw 14 feet 9″ diameter, and 21 feet 6″ pitch. Draught 16 feet 6″ aft. The main journals to carry this work are 12¾″ diameter, and 12″ long, six in number.

We must now design a set of boxes for this shaft, and so arrange them that they can at any time be removed without lifting the shaft from the boxes, or disconnecting the connecting rods. We shall therefore select the circular form of bronze shell for these boxes, for the reason that this design is the simplest, strongest, and cheapest, and also because it has been well tried on some of the largest steamships afloat, and is a success. The outside surface of these shells or boxes is turned concentric with the journal, the boxes being in halves. The shell at the portion next to the bearing for our 12¾″ shaft will be 1⅝″ thick, fitted with staves of babbitt or best quality of white metal ⅝″ thick, and 2″ wide, placed 1″ apart, and running the entire length of the box. A water or cooling space comes next, 1⅛″ wide, and then the outer thickness of metal ⅞″. The whole thickness of box then, is 3⅝″, so the bed plate housings must be bored to a diameter of 20″. There will be no flanges on these boxes or shells, but there will be a central groove bored in the housing ⅝″ deep and 2″ wide to match a raised ring turned on the outside of the box shell, to keep it in its proper position fore and aft. Both half sections will be pocketed for oil, with channels at each end and at the center, leading to the "Albany" grease cups. Each box will be connected with a pressure oil pump, so that in case of a sluggish movement of the oil, a passage can be instantly forced by the pump. With this pump, cooling compounds can be forced through all the crank-shaft boxes in case of heating. Then again, after a free use of the shower bath, the fresh oil can be circulated through all the oil channels, by means of the pump. By raising the shaft $\frac{1}{16}$ to $\frac{1}{8}$ of an inch by jacks, the lower half section of the shell can at once be rolled out of the bed-plate, after first removing the caps, the top half of the shell, and the water and oil pipes. Of course the water spaces in the shells are all connected by brass pipes which lead to a circulating pump. The circular design for marine engine shaft boxes is the strongest, and the bed-plate is also left in its most rigid form, by the large arch surrounding one-half of the box shell. Square jaws, or box seat openings in a bed-plate weaken the structure, and add greatly to the expense of fitting in the box shells, and arranging the caps. These circular boxes are prevented from turning or moving in their seats in the bed housings, by simply flattening the top side of the upper section of the shell a little, as the liners between the two halves "chock" the lower shell to the upper one, and thus keep both from turning with the shaft.

The "babbitt" or white metal staves must be planed or otherwise machined to gauge, then inserted in a cast-iron "dummy" frame or bed, and bored to size by a traveling cutter-head. Any required number of these staves can be taken as extras in the engine room stores, and inserted in the shells when necessary, as the old ones can be driven or sawed out without trouble.

The caps for holding down the top boxes will be of forged steel, rough planed and bored to fit the shell two to each bearing, each 4½″ wide by 3¾″ thick, and 29″ long. Each set of boxes will be held down by four 1¾″ steel bolts, making eight bolts for each piston to pull against. These bolts will be fitted with check nuts and guard rings. There will be special socket wrenches, well fitted to the nuts for tightening and adjusting the caps. It will be observed that by adopting the circular form of boxes, the bed-plate housing and caps can be bolted together, then placed on a large lathe, or horizontal boring apparatus, and the whole set of box seats bored accurately to size in one operation.

This system costs about one-third of the amount required to plane in a set of boxes, and as for the accuracy of the work, the planing system is not to be compared with the circular plan. The latter method insures perfection in every way, especially in the matter of alignment.

Thus we have prepared a set of bearings for our crank shaft, that have all the requirements for heavy sea service. The box shells will not warp with heat, and it is simply impossible to break them. They can be readily removed in case of accidental cutting, and quickly reseated with babbitt, or white metal strips.

Many practical marine engineers are not in favor of white linings of any kind for main shaft, and pin journals, and, at one time, none of them would allow this metal to be used. This prejudice has gradually worn off, under the repeated successful trials of good white metals, on large engines using very high steam, and quick rotation.

None of the main bearings should be closely fitted on a marine engine, yet this is an aggravating error often met with in new work. There must be ample room for the lubricants between the shaft and the box, otherwise the troubles are never-ending. There must be sufficient fore and aft play in the crank-shaft, and crank-pin journals, and this is a point frequently neglected. The thrust block, if a good one, will always take care of the shaft as to the fore and aft movement, therefore the clearances between shoulders, on all the main bearings, can and should be large. The corners of the journals must, of course, be well rounded up to the shaft body entering the crank plates, and the corners of the box shells must be rounded to match. The body of the shaft should be raised from $\frac{1}{16}$ to $\frac{1}{8}$ the journal's diameter above the surface of the journal, so the body of our shaft would be at least 15¼″ diameter. The cap bolts should be placed within ¼ of an inch of the outer surface of the box shell, in order to reduce the span of the caps as much as possible. Space is also a great item at this point of the bed, as the men must have room to handle wrenches and other tools of adjustment in case of accident or overheating. The lower seatings for the heads of the bolts must be faced true and square with the other machine work on the bed-plates, thus rendering the whole cross-section of the bolt available, and this precaution must be taken with every important bolt seat on the engines. All keys must follow the same rule. A large new compound engine in a well-known mill has just been wrecked by a badly-fitted cross-head key; less than one-third of the key surface being available. This kind of work is little less than criminal in marine engine construction, and happily we meet little of it.

Practical Drawing.

By J. G. A. Meyer.

Forty-eighth Paper.

Problem 61.

430.—*Practical Application of the Last Two Problems.*

In our last problem we found the form of the openings in the sides or lateral faces of a prism, made by passing a cylinder through it. In that problem we assumed the sides or lateral faces of the prism to have no thickness; in fact, in our last problem we dealt with geometrical magnitudes. In practice we deal with physical bodies, and therefore thickness cannot be left out of consideration. Yet the laws and principles developed in dealing with geometrical magnitudes are applicable to, and will greatly aid us in, the solutions of practical problems, as we shall endeavor to show in the following problem:

Figs. 321, 322. Let $a\ a_3$, $b\ b_3$ be the vertical, and $a_2\ b_2\ c_2\ d_2$ the horizontal projection of a hollow prism, or a box having its top and bottom removed. The outer surface of this box is represented in Fig. 322 by the large square $a_2\ b_2\ c_2\ d_2$, and the inner surface by the small square $n_2\ o_2\ p_2\ r_2$; consequently the thickness of any one of the sides of the box will be equal to the distance between any two parallel sides of the large and small square. Also let $g\ l\ i\ m$ represent the vertical, and $f_2\ g_2\ k_2\ i_2$ the horizontal projection of a cylinder which is passed through the box, as shown, with its axis $h_2\ l_2$, in Fig. 322, coinciding with the diagonal $c_2\ d_2$. The lines $a_2\ n_2$, $b_2\ p_2$, $c_2\ o_2$ and $r_2\ d_2$ represent the joints between the sides. It is required to lay out, or to make a complete drawing of one of the sides of the box, so that when the four sides of the box are made, with the opening cut into each side, according to the drawing, and the four sides put properly together, the cylinder will pass through the openings thus made, and fit them accurately throughout.

Through the center e of the circle in Fig. 321 draw the horizontal line $g\ i$, cutting the circumference in the points g and i. Divide the radius $e\ i$ into any number of equal parts, say three, and mark the points of division e_3, e_4. Through the points e_3, e_4 and i draw vertical lines terminating in the bases $a\ b$ and $a_3\ b_3$. The lines $t\ t_3$, $t_4\ t_5$, $t_6\ t_7$ will represent the vertical traces of cutting planes which are perpendicular to the vertical plane of projections. These cutting planes are, of course, assumed to be passed through the prism and cylinder; the line $t_6\ t_7$ is tangent to the circle, and producing the line $t_6\ t_7$ towards Fig. 322 will form one straight line with the element $k_2\ i_2$, or, in other words, we may say that the line $t_6\ t_7$ and $k_2\ i_2$ will lie in one straight line. Prolong the lines $t\ t_3$ and $t_4\ t_5$ towards the horizontal projection in Fig. 322, and cutting the side $c_2\ b_2$ in the points t_8, t_9, also cutting the inner surface $o_2\ p_2$ in the points $s_8\ s_9$. The prolongations of these lines, that is $t_3\ s_8$, $t_5\ s_9$, and also $t_7\ s_{10}$, may be regarded as the horizontal traces of the same cutting planes which are represented in Fig. 321 by the $t\ t_3$, $t_4\ t_5$, and $t_6\ t_7$. Now, comparing the construction in Figs. 321, 322, as far as we have gone, with that in Figs. 317, 318, and explained in Art. 426, we find that both constructions, so far, are alike, although the dimensions of the prism and cylinder in the two problems differ.

In the problem before us we have to deal with a hollow prism, and therefore at first sight it may appear to the reader that the construction shown in Figs. 317 and 318 will not be applicable to the solution of the present problem. But such conclusions are wrong, because we may consider the inner space of the prism, that is, the space bounded by the sides $n_2\ o_2$, $o_2\ p_2$, $p_2\ r_2$ and $r_2\ n_2$ (Fig. 322), as a geometrical magnitude (see Art. 18), or as a separate prism, and then find the form of the openings in the lateral faces in this prism, as explained in Art. 426 (last paper). After the form of these openings has been obtained we then treat our problem as if we had only one prism bounded by the sides $a_2\ c_2$, $c_2\ b_2$, $b_2\ d_2$, and $d_2\ a_2$, as shown in Fig. 322, and then find the form of the openings in these sides or lateral faces in a manner precisely similar to that given in Art. 426. Now, let us adopt this mode of procedure, and thus find the true form of one of the sides of the box, as shown in Fig. 323.

The distance between the lines $a\ b$ and $a_3\ b_3$, Fig. 321, shows the correct height of the prism, therefore, and for the sake of convenience, we prolong the lines $a\ b$ and $a_3\ b_3$ towards the right, and at any convenient distance from the edge $b\ b_3$ we lay off on the line $a\ b_4$ two points, namely, o_4 and p_4, making the distance between these points equal to that between the points o_2 and p_2 in Fig. 322. Through the points o_4 and p_4 draw the vertical lines $o_4\ o_5$ and $p_4\ p_5$ terminating in the line $a_3\ b_3$. The rectangle $o_4\ p_4\ o_5\ p_5$ will represent the inner surface of one of the sides of the box. To find the form of the opening in this surface, prolong the line $g\ i$ towards i_4, cutting the line $o_4\ o_5$ in the point e_5. From this point, and on the line $e_5\ i_4$, lay off a point i_4; the distance between the points e_5 and i_4 must be equal to the distance between the points o_2 and s_{10} (Fig. 322). Now, because the distance $o_2\ s_{10}$ shows the extent of the opening in the surface represented by the line $o_2\ p_2$, it follows that $e_5\ i_4$ represents the extent of the opening in Fig. 323, and the point i_4 will be a point in the outline of the opening. Again, because the distance between o_2 and s_{10} has been divided into three equal parts, we also divide $e_5\ i_4$ into three equal parts, and thus obtain the points of division marked e_6, e_7. Through these points draw the vertical lines, terminating in the lines $o_4\ p_4$ and $o_5\ p_5$. From the point e_5 (Fig. 323) as a center and with a radius equal to $e\ l$ in Fig. 321, describe two small arcs, cutting the line $o_4\ o_5$ in the points l_5, m_5; these will be another two points in the required curve. From e_6 as a center, and with a radius equal to $e_3\ l_3$ (Fig. 321), describe two arcs cutting the line $s_{11}\ s_{12}$ in the points l_6, m_6, which will give us another two points in the curve, and lastly from the point e_7 as a center, and with a radius equal to $e_4\ l_4$, describe two arcs cutting the line $s_{13}\ s_{14}$ in the points l_7 m_7. Join the points $l_5\ l_6\ l_7\ i_4\ m_7\ m_6\ m_5$ by a curved line, which will be the true form of the opening in the inner surface of the side of the box. Since the bases $a\ b$ and $c_4\ b_4$ in Figs. 321 and 323 lie in one straight line, the points l_5 l_6, etc., (Fig. 323) could have been obtained by drawing horizontal lines through the points l l_3 (Fig. 321), or, as the draftsman would say, by squaring the points l, l_3, etc., across, instead of describing short arcs from the points e_5 e_6, etc., as centers.)

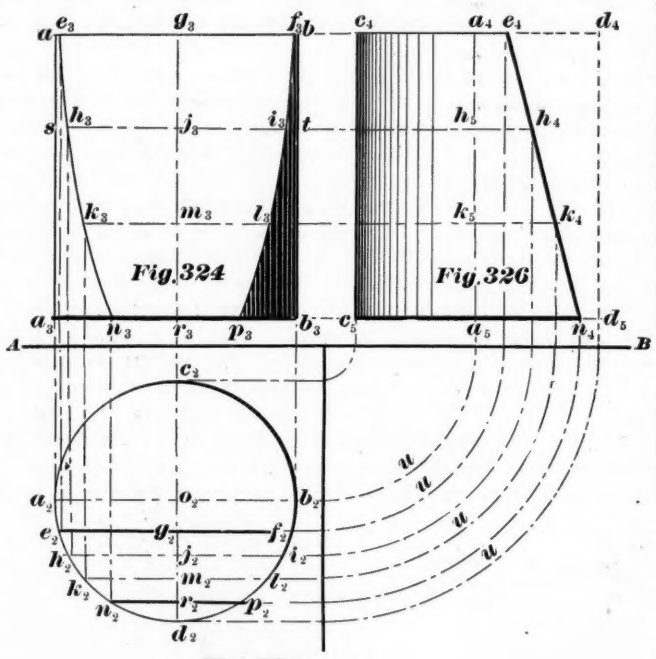
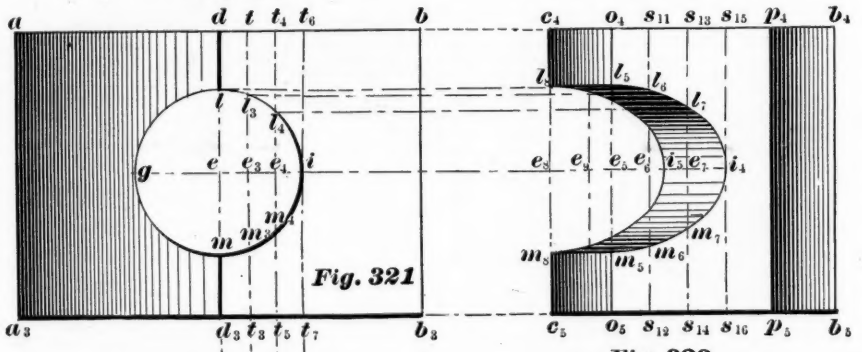


Fig. 325



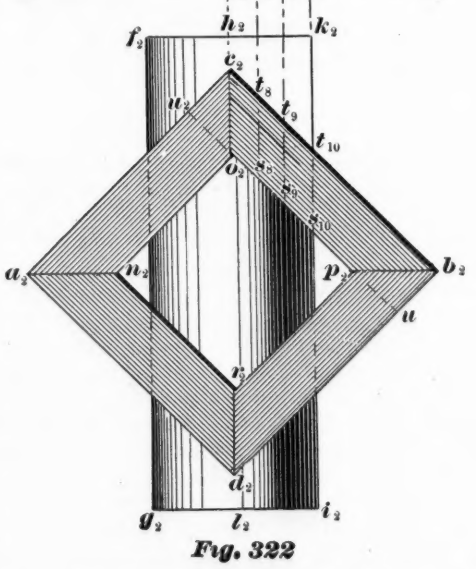


Fig. 322

Comparing this method of finding the curve, with the method given in Art. 426, we find that both methods are alike.

To Find the Form of the Openings in the Outer Surface of the Sides.

The outer surface of any one of the sides of the box is, of course, wider than the inner surface of the same side, and the differences of the widths of these surfaces are plainly shown in Fig. 322; here, for instance, the difference between the width of the outer surface $c_2\ b_2$ and the inner surface $o_2\ p_2$ of the same side is plainly and correctly shown. It must also be noticed that, since the sides are all of equal thickness, and the sides perpendicular to each other, the distance $u_2\ o_2$, which represents the amount of projection of the edge c_2 beyond o_2, is equal to $p_2\ u$, which is the amount of projection of the edge b_2 beyond p_2; and the amount of each one of these projections is equal to the thickness of a side. Therefore, in Fig. 323, lay off from the point o_5 on the lower base a point c_5, the distance between these two points must be equal to the thickness of a side; again, from the p_5 on the lower base lay off a point b_5; the distance between these two points must also be equal to the thickness of a side. If the points c_5 and b_5 have been laid off correctly, then the distance between c_5 and b_5 will be equal to $c_2\ b_2$ in Fig. 322. Through the points c_5 and b_5 draw vertical lines terminating in the upper base $c_4\ b_4$, then the rectangle $c_4\ c_5\ b_4\ b_5$ will be the correct outline of the outer surface of a side.

Now notice in Fig. 322 that the cutting planes intersect the inner surface $o_2\ p_2$ in the lines which are represented by the points s_8, s_9, s_{10}, and the outer surface $c_2\ p_2$ in t_8, t_9, t_{10}, making the extent $c_2\ t_{10}$ of the opening in the outer surface equal to $o_2\ s_{10}$, the extent of the opening in the inner surface, also the distance $c_2\ t_8$ equal to $o_2\ s_8$, and $t_8\ t_9$ equal to $s_8\ s_{10}$. Therefore, the line $t\ t_3$ in Fig. 321 will not only represent the line in which the cutting plane intersects the inner surface, but also represents the line in which the cutting plane intersects the outer surface. The same remarks apply to the other lines, that is to say, the lines $t_4\ t_5$ and $t_6\ t_7$ represent lines in which the cutting plane intersects the inner and outer surfaces of that particular side; and therefore the width of the opening in the outer surface on these lines ($t\ t_3$, $t_4\ t_5$, $t_6\ t_7$) must be equal to the width of the opening in the inner surface on the same lines; in short, the form of the opening in the outer surface is precisely the same as the opening in the inner surface. Hence in Fig. 323, from the point e_3, in which the line $g\ i_4$ cuts the edge $c_4\ c_5$, lay off, on the line $g\ i_4$, a point i_5, the distance between the points e_3 and i_5 must be equal to $c_2\ t_{10}$ in Fig. 322. The distance from e_3 to i_5 represents the extent of the opening in the outer surface, and will be equal to $e_5\ i_4$, the extent of the opening in the inner surface. Again, from the point e_3 as a center, and with a radius equal to $e\ l$ (Fig. 321) describe two short arcs cutting $c_4\ c_5$ in the points l_8 and m_8, which is the greatest width of the opening. Then find other points in this curve in a manner precisely the same as that adopted for finding the points $l_6\ l_7$, etc., in the inner opening, and thus complete the outline of the opening in the outer surface, making the form of the outer and inner openings exactly alike.

If now the sides are made to the outline shown in Fig. 323, and properly put together, they will form a box with openings, through which a cylinder of the dimensions given can be passed and fit the openings accurately throughout.

Directions.—Prepare another sheet by dividing it into the same number and size of spaces as in the previous sheets, and mark the spaces, Prob. 61, 62, 63, etc. In the space marked Prob. 61 draw the vertical and horizontal projections of a hollow prism and a cylinder, as shown in Figs. 321, 322. The height of the prism is to be 2 feet 3 inches, and 2 feet square outside. The thickness of the sides is to be 5 inches. Diameter of the cylinder 15 inches, and its length 2 feet four inches. Make a correct drawing of one of its sides, as shown in Fig. 323, according to the instructions given in this problem. Use a $\frac{3}{4}$-inch scale.

It will be excellent practice for the student to cut four wooden sides, according to his drawing, and put them together to form the box, and then find how near they will fit the cylinder when it is passed through the openings. This will be a test of his accuracy and skill, and enable him to obtain a clearer conception of the principles involved.

Problem 62.

431.—*To Find the Intersections of a Cylinder and a Plane which is not Parallel to the Axis of the Cylinder.*

Fig. 326. Let $c_4\ c_5\ d_4\ d_5$ represent the vertical projection of a cylinder, and the line $e_4\ n_4$, a plane passed through the cylinder; it is required to find the vertical projection of the same cylinder, in which the true distance between the curves of intersection can be seen.

In Art. 405 we have shown, that when a cutting plane is passed through a cylinder parallel to the axis of the same, the lines of intersection in the cylindrical surface will be straight lines, and will also be parallel to the axis; in short, the cutting plane will intersect the cylindrical surface in two elements.

In Fig. 326 it will be noticed that the cutting plane $e_4\ m_4$ is not parallel to the axis $a_4\ a_5$, and therefore, as we shall now explain, the lines in which the cutting plane intersects the cylindrical surface, cannot be straight lines, but will be curved lines.

In Fig. 326 we see the cutting plane $e_4\ n_4$ standing perpendicular to the vertical plane of projection, and consequently we can only see, so to speak, the edge $e_4\ n_4$ of the cutting plane.

This cutting intersects the upper base $c_4\ d_4$

of the cylinder in a line which is represented by the point e_4, and since the upper base, or, more strictly speaking, the plane of the upper base, is also perpendicular to the vertical plane of projection, it follows that the line in which the cutting plane intersects the upper base must be a straight line, which, in this particular view, will be perpendicular to the vertical plane of projection. If we now wish to see the correct length of a limited portion of this line, we assume that the dotted portion of the cylinder has been removed, and then turn the cylinder around its axis until the line of intersection through e_4—which is perpendicular to the vertical plane of projection—becomes parallel to the vertical plane of projection. The appearance of the cylinder (having the dotted portion removed), in this new position, is shown in its vertical projection, Fig. 324; the line $e_3 f_3$ (which is represented by the point e_4, Fig. 326) is now parallel to vertical plane of projection, and its correct length, as well as the correct horizontal distance between points in the curves of intersection can be seen.

In order to find the curves of intersection in Fig. 324, we proceed as follows:

Let A B be the ground line. At any convenient distance from Fig. 326 draw the vertical projection a a_2 b b_2 of the cylinder in such a manner that the upper base a b in Fig. 324 and the upper base c_4 d_4 in Fig. 326 will lie in one straight horizontal line. Draw the center line g_3 r_3 and produce it below the ground line A B. At any convenient distance below the ground line draw the horizontal projection of the cylinder, which is simply the circle a_2 b_2 c_2 d_2, having its center o on the center line g_3 d_2.

Divide the line e_4 n_4 (Fig. 326) into any number of equal parts, say three, and through the points of division h_4 k_4, draw the horizontal lines h_4 h_3, k_4 k_3, cutting the line a_4 a_5 in the points h_5, k_5 and the center line g_3 r_3 in the points j_3, m_3.

From the center o_2 on the radius o_2 d_2 (Fig. 325) lay off a point g_2; the distance between these points must be equal to that between a_4 and e_4 (Fig. 326); also from o_2 lay off, on the line o_2 d_2, a point r_2, making the distance between o_2 and r_2 equal to a_5 n_4. Divide the distance between g_2 and r_2 into three equal parts and through the points of division j_2 and m_2, also through g_2 and r_2 draw lines parallel to the ground line A B, and terminating in the circumference of the circle, and thus obtain the points e_2, h_2, k_2, n_2 on the left of the center line g_3 d_2, and the points f_2, i_2, l_2, p_2 on the right. Through the point e_2 draw a vertical line, cutting the upper base a b (Fig. 324) in the point e_3; through h_2 draw the vertical line, cutting the line h_3 h_4 in the point h_3; through k_2 draw the vertical line, cutting k_3 k_4 in the point k_3; and through n_2 draw the vertical line, cutting the lower base in the point n_3. Join the points e_3 h_3 k_3 and n_3 by a curved line which will be one of the lines in which the given cutting plane intersects the cylindrical surface. In a similar manner the other curve of intersection f_3 i_3 l_3 p_3 is found.

The line e_2 f_2 in Fig. 325 represents the line in which the cutting plane intersects the upper base of the cylinder. The length of this line is limited by the circumference a_2 b_2 c_2 d_2. By construction the line e_3 f_3 in Fig. 324 is equal to e_2 f_2 in Fig. 325; in fact, e_3 f_3 is the vertical, and e_2 f_2 the horizontal projection of one and the same line, and this line is the one in which the given cutting plane intersects the upper base of the cylinder. Here then we may say that the cutting plane contains the line (e_3 f_3, e_2 f_2) and also the curves of intersection; and since the extremities e_3, f_3, of the line e_3 f_3 lie in the cylindrical surface, the points e_3 and f_3 must be points in the required curves. The lines n_3 p_3 and n_2 p_2 are the projections of the line in which the given cutting planes intersect the lower base of the cylinder, and for similar reasons given in reference to the line (e_3 f_3, e_2 f_2) the points n_3 and f_3 must be points in the required curves of intersection.

Once more. Assume that an auxiliary cutting plane, perpendicular to the vertical plane of projection, is passed through the line h_3 h_4, and the portion of the cylinder above this plane removed, then the line s t will represent the upper base of the cylinder. In this case the line h_3 i_3 will be the vertical, and the line h_2 i_2 the horizontal projection of the line in which the given cutting plane intersects the upper base s t; the extremities (h_3 h_2) (i_3 i_2) of this line lie in the cylindrical surface, and therefore these extremities must be points in the curves of intersection. The same reasoning applies to the line (k_3 l_3, k_2 l_2) and in this manner, by increasing the number of divisions in the line e_4 n_4 (Fig. 326), any number of points in the curves of intersection can be found. In fact, the more points found the more accurate will be the curve. The arcs u u u are simply drawn to indicate the correct relative positions of points and lines in the three different views, and also to show the principles which govern the positions of the three different views, which have been explained in Art. 309.

432. It must be remarked here that although Fig. 324 shows the correct vertical projection of the cylinder, having one portion of the cylinder, separated by the cutting plane, removed, and also shows the correct horizontal distance between any two points in the curves of intersection, the true form of the curves e_3 h_3 k_3 n_3 and f_3 i_3 l_3 p_3 is not shown. The manner of finding the correct form of these curves will be explained in our next paper.

Directions.—In space marked Prob. 62 draw a vertical projection of a cylinder, as shown in Fig. 326. The cylinder is to be seven inches in diameter and eight inches high. Through this cylinder assume a cutting plane to be passed, which is represented by the line e_4 n_4. The extremity e_4 is to be one inch from the a_4, and the extremity n_4 is to be three inches from a_5. Then find the vertical and horizontal projections of this cylinder, as shown in Figs. 324, 325. Use a three-inch scale.

Another Iron Workers' Society.

The following, which we received from Wm. Ferguson, foundry foreman of the Ottumwa Iron Works, Ottumwa, Iowa, and secretary of the society referred to, will explain itself:

Some two months ago I sent out some circulars calling a State meeting for the purpose of forming an association of iron workers. We met at Grinnell, Iowa, on the 23d and 24th ult., and although we were few in numbers, we were strong in good material, and as a result we formed what will be known as The Master Iron Workers' Association, of Iowa, which will include in its members' list the proprietors and foremen of the following departments: machine shop, foundry, blacksmith and boiler shops. Its objects will be the education and elevation of its members on subjects pertaining to the iron industry, by holding meetings at stated periods for the reading and discussion of subjects pertaining to the different trades, and to assist in the development of Prof. Torrey's experimental station at Grinnell, a description of which has already appeared in your paper.

I must state here that Prof. Torrey entertained us in an able manner, and that as a worker for the good of the cause he has few equals. Our officers for the first year are:

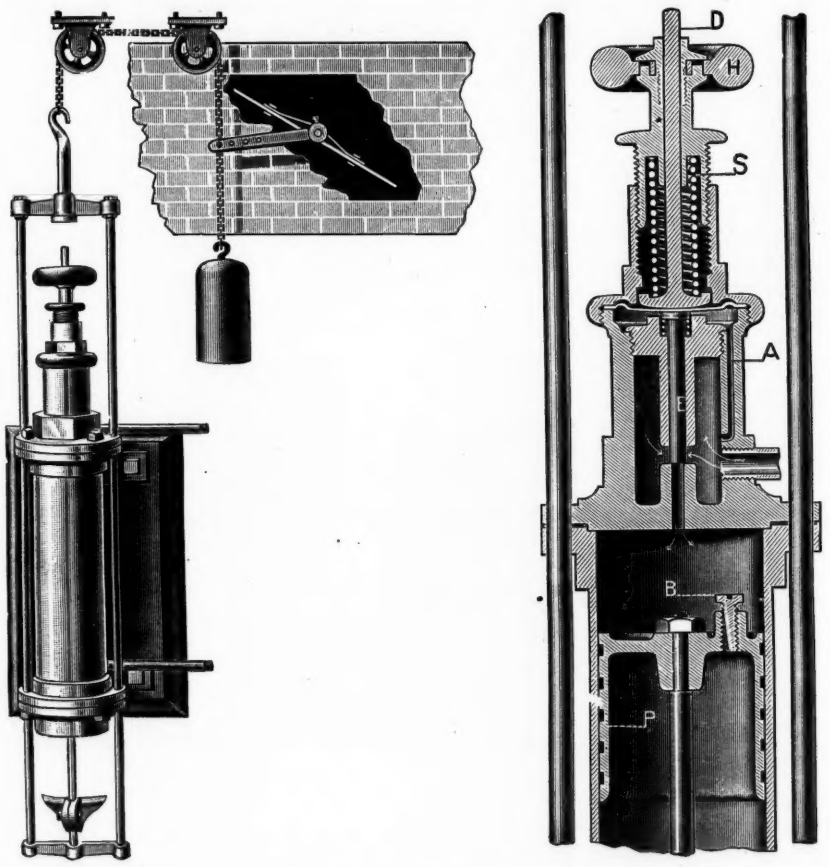
President, M. Austin, Grinnell; vice-president, F. H. Whiting, Cedar Rapids; secretary and treasurer, Wm. Ferguson, Ottumwa.

Our next meeting will be held at Cedar Rapids early in July, due notice as to date and subjects discussed to be given later on.

The Curtis Damper Regulator.

We illustrate on this page an improvement which has been made in the well-known Curtis Damper Regulator, manufactured by the Curtis Regulator Company, of Boston, Mass.

In this device the principle of the Curtis pressure regulator has been applied to the movement of a damper in the flue of a steam boiler, so as to obtain uniformity of boiler pressure. It is said that these damper regulators can be made to open and close the damper with a variation of boiler pressure inside of one pound.



The Curtis Damper Regulator.

The full view shows it as attached to a damper, and the sectional view shows the operating parts. Steam is brought in a $\frac{1}{4}$" pipe from the boiler to the chamber surrounding the valve E. This pressure is also carried through the side pipe A to the diaphragm. By turning down on the handle H the spring S is compressed, loading the diaphragm with any given weight, thus holding the valve E to its seat. When the boiler pressure in the valve chamber rises high enough to lift this load, the valve opens, say $\frac{1}{100}$ of an inch, admitting the steam to the top of the piston P, pushing it down to the bottom of its stroke, overhauling the chain and closing the damper.

The improvement to which we call attention consists in extending the stem D of the follower (which rests on the phosphor bronze diaphragm) up through the handle to such a length that the yoke rests on it when the damper is sufficiently closed, thus forcing the valve E to its seat, and cutting off the flow of steam into the piston chamber. The piston starting back relieves the pressure on the spindle D, permitting the valve E to open again, providing just the needful pressure in the cylinder to hold the damper closed until the boiler pressure falling, say one-half pound, has no longer power to open the valve, and the weight opens the damper.

The condensation in the chamber over the piston passes through the adjusting screw B, being carried away by a small drip pipe into the ash pit.

Another improvement consists in making the piston P quite long, a loose fit, and putting in water grooves, which make a tight water packing to a perfectly free piston. It is claimed that this arrangement, while very sensitive, is particularly valuable in places where dirt, ashes, etc., are likely to clog the operation of ordinary mechanical devices. Taking the steam from the boiler at full pressure, all the power necessary to move the damper under all practical difficulties is available. While so much power is not necessary in the well-kept boiler room, there are many steam boilers that need powerful regulators, as where the dampers become rusted and clogged with dirt.

Notes on British Shop Practice.

By A. G. Brown.

There are many things amongst the machine shops in this country that appear strange to American observers. Many will bear close inspection, and create a desire to copy, if one ever has the chance; while others again only excite surprise and even disgust that material and labor can be so wasted. (They call it "labour" here, even wasting a letter on the word.)

In Scotland a favorite style of machine shop is of one-story, with a saw-tooth roof, with the lower part of the tooth 12 to 16 feet from the floor. It makes an excellent shop in many respects. There is no raising and lowering of material and finished work, and no running up and down stairs of the workmen, moreover, and this is an important consideration. The building is cheap to construct. The shops are made, if possible, nearly square, the saw teeth or corrugations running straight across. The teeth are usually spaced about 16 feet, and are supported by cast-iron columns, spaced 16 feet each way. The projection of the roof is very nearly the shape of a tooth in a straight saw intended to cut in one direction only, and is 7 to 8 feet high for a 16-foot tooth, the side that is nearly vertical being fitted with glass about 6 feet wide, extending continuously the whole width or length of the building, according to which way the corrugations run. If possible, the glass side of saw tooth fronts the north, to avoid the sun shining into the shop, as this is very disagreeable on a bright summer day. It will be readily seen that this arrangement gives an abundance of light, no matter what the width of the shop may be.

The columns supporting the roof are arranged to carry the line shafting, and by means of brackets, the countershafting for the machine tools, and support in many cases, in addition, a track above, on which, and projecting into the tooth of the roof, a traveler runs; as the central space is entirely clear of shafting, pulleys or belts, the traveler commands all the machine tools placed in that bay.

Taken from the floor up, the arrangement is a good one, but they spoil the shop in many cases by having only a dirt, or so-called, concrete floor. Not only is there dust and grit continually rising to injure the machinery, but in Scotland, as the ground is never dry, a piece of finished work laid down will soon rust, and the comfort of the workmen is not in any way considered.

There are, in most of the shops, no means of warming them, and the mercury gets pretty low sometimes; not, of course, as low as in New York, as no man could stand that and work without being warmed; but it is a damp, penetrating cold, entirely different in its effects from the crisp dry air of the States. To go into a cold shop at six in the morning, stand on a dirt floor and endeavor to do three hours' work before breakfast, is not a pleasant prospect to one unaccustomed to this kind of life. I have never done it, and much prefer to lie in bed and think it over.

The hours the men work seem bad, from both employed and employers' points of view. They start at six in the morning and work until nine, then one hour is allowed

for breakfast; starting again at ten and working until one in the afternoon; stopping one hour for dinner, starting again at two and leaving work at half-past five. On Saturday they only have half an hour for breakfast, and stop for the day at one o'clock, working in all 54 hours per week.

It appears wrong to expect a man to do an honest day's work when he has to go to work so early that he cannot have his breakfast first; also by breaking the day's labor into so many portions there must be a great amount of time wasted that would be saved by adopting the American plan. But the men prefer it, or, at any rate, say they do, and scout the idea of working five hours without eating.

The arrangements for checking the men's time are usually very good; one of the best was controlled by a clock as follows: Each man was given a number and a brass check bearing that number was hung on a rack, or board, containing a number of hooks, placed in an entry adjoining the time keeper's office. Each man as he entered took his check from the rack and dropped it through a slit in the clock case; the men were watched so that only one check could be inserted. The checks fell into a box in the lower part of the clock case, and this box was changed by the clock every 15 minutes, *i.e.*, from 5:45 until 6 o'clock. The box marked six o'clock would be under the slit and receive all the checks dropped through the slit. At exactly six o'clock the clock would swing the box marked 6:15 into position, and if a man was one minute late the clock would dock him 15 minutes. There was no disputing with this time-keeper, and the manager or superintendent of the works stated that it had wonderfully improved the men in getting there on time.

They did not take the time of the men leaving, unless they were working overtime, as the men could not leave the works before the regular quitting time, unless on account of accident or sickness.

The clumsiness of the average lathe affects one unpleasantly. It is only by considerable effort that the slide rest on an 18 or 20 inch lathe (they would call this a 9 or 10 inch lathe here, as they measure the radius, and not the diameter)—can be moved along the ways, and on a 36 inch it takes a helper with a bar or piece of pipe to move the rest any considerable distance. The handle with which this movement is effected has evidently been designed with this in view, for instead of a wheel with a handle in it, as on many American lathes, it is usually a cast hub with four wrought bars forming a cross, over the ends of which a pipe can be, and usually is, slipped to assist in turning it. A taper attachment is almost unknown, and is frowned upon as a senseless innovation.

The tools are clamped on the crosshead with two clamps and four studs; occasionally a set screw is added, to make all secure. It is slow work changing tools, but they rarely slip when once set. This practice has probably been copied from the large machines, on which a tool cannot be held too firmly, and the time can well be afforded that it takes to set it; but the conditions are so different with the small machine that the practice should be modified; where short jobs are the rule, ease of working and quickness in changing tools should be studied. Messrs. Smith & Coventry, of Salford, are introducing tool holders and tools which compensate for this defect, and where the system is carried out is an excellent one.

The tool holder is clamped as usual, and carries the tools, which consist of short pieces of steel, two to three inches long, cut from the bar. These tools are held at the proper angle with the work for cutting, and can be removed, or the position changed, at pleasure, without moving the tool holder. The steel ordinarily used for the tools is made in four shapes—round, square, three-cornered, for side cutters, and flat, with thick and thin edge, for cutting off. In the shop each man is supplied with eighteen or twenty assorted tools, placed upright in a block of wood. As they are dulled by use, he reverses them in this block. Once or twice a day a man goes around gathering up these dull tools and replacing them with sharpened ones. The tools are ground in a special frame on the grindstone, so that the angle shall be correct, and is ground on face of the tool or end of the piece of steel, so the shape never changes.

The best chucks here are of American manufacture, and are well liked wherever used, but too few of any kind are used. Fancy a machine shop employing nearly four hundred men on general work, and but two chucks in it; and imagine, if you can, the time lost in rigging up clamps, etc., on a face plate, to hold work that should be chucked.

The lathes are almost always made with a gap; that is, a piece of each of the ways is arranged to be taken out, so as to swing a larger diameter close to the face plate. This comes from a desire to make one lathe turn anything. Any one familiar with gap lathes will understand that they won't, besides they spoil the slide rest, and it is impossible to get the pieces back true.

Cast gears are the rule and cut gears the exception, though the latter are coming slowly into use. Some of the best firms advocate them, notably Messrs. Thomas Shanks & Co., of Johnstone, who have some American gear cutters. This firm makes tools of the largest description. Some time since I saw a lathe there intended for turning pieces of 100 tons in weight. Many of the cast gears run very well, nearly as quiet as cut gearing, but the majority of them run very noisy, sometimes painfully so, as it gives the impression that next time it will break, until you wish it would, to end your suspense. Occasionally they do break, and then they carefully take the old broken gear and make a nice new casting from it, and when it is started again you wish, more than ever, that it would break.

The ways of the lathe are flat and usually strewn with tools; no attention is paid to preserving their truth, and they are usually covered with marks of carelessness. A tool board on a lathe is very rare indeed.

I saw a man driving a mandrel into a piece of cast-iron laid on the ways of his lathe. This was not the usual practice of that shop, for the foreman came and reprimanded him—told him *he must not do that.*

New Building for the Mechanical Engineering Department of Vanderbilt University.

The Nashville *Democrat* has this to say of the new building for the department of mechanical engineering now being erected by he Vanderbilt University, Nashville, Tenn.:

The building will be located on the south side of the road leading from the Broad street gate to Science Hall, just off the fork of the road facing West End avenue. The building will be L-shaped. The front will be two stories high, and the L wing one story, the extreme end resting within 60 feet of the Hillsboro pike. The front of the building will be 63 feet wide and 38 feet deep, and will contain a recitation room 35 feet square, a hallway, office of the professor of mechanical engineering, and a tool-room 12 by 15 feet. Behind this will be the machine shop, 50 by 55 feet; the engine-room, 30 by 25 feet, and the wash-room. In the second story will be located the drawing-room, 35 by 60 feet, and the carpenter shop, 50 by 80 feet. The first wing will contain the forge shop and foundry, which will be 40 by 40 feet, the pump-house 10 by 40 feet, in which will be placed the large pump for filling the tank which supplies the campus with water, and also the small pumps for the boilers. At the extreme end will be the boiler-house, which will be 35 by 40 feet, and will contain four Babcock & Wilcox boilers. The chimneys for these boilers will be 120 feet in height, and at such area as to give sufficient draft to consume the coal, and thereby dispense with the volume of smoke which has so long been an annoyance to the dwellers on the campus. The engine-room will contain a new Corliss engine, which will supply the motive power of the shops. The machine shops, when completed, will be one of the most unique and complete in Nashville. The carpenter shop will contain a large universal wood-worker, together with a circular saw and wood-turning lathes. There will be 17,000 feet of space in the building.

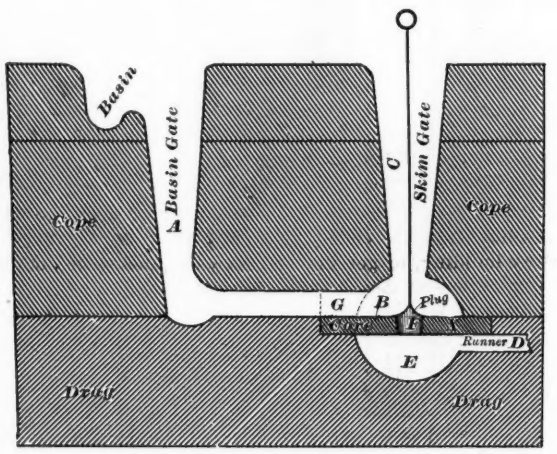
LETTERS FROM PRACTICAL MEN.

The "Texas" Skim Gate.

Editor American Machinist:

Enclosed I send sketch of what I believe to be a new wrinkle in skim gates. After many trials on castings which required to be clean, I find it to be the best I have ever used. As a further trial of it, after placing the plug in position, as seen in sketch, I threw a handful of sand down gate *c*, just before pouring, and did not skim the ladle when pouring. The casting, which was a plain plate 2″×12″×2′6″, when put on the planer and cut taken, showed up nice and clean. With any other skim gate that I know of the result would not be hard to guess; an addition to the scrap pile.

The gate shown in sketch was made from a 4″ ball pattern, with core print 1″ thick by 8″ diameter; the hole in center of core tapering from 1¼″ to 1″. The flow of metal can be regulated so as to suit any size casting by increasing or decreasing the size of hole in the core. Any number of the gates can be used on the casting as thought proper. As shown in sketch, the iron goes down *A* into *B*, and rises up *C* until both *A* and *C* are full. Then draw plug *F* and permit the iron to run through the hole in core *X* into the bottom basin *E*, and out through runner *D* into the casting. Be sure when pouring always to keep a head of metal; all gates should be full.



Skim Gate.

If, in pouring a piece, you should run short, I believe that, by quick work, you could prevent any of the dross or sullage from entering the casting, by replacing the plug *F*, thereby sealing the mould or gates, and giving time to have more metal brought up to continue the pouring. I have never been compelled to do this, but several times while pouring have thrust the plug into its seat when the gates would refuse to take more metal.

The pieces *G* and *D* are loose, so that if desirable you can get a right or left hand whirl by placing *G* in the position required. I have christened it the "Texas skim gate," and offer it to foundrymen, with the request that those who see fit to test it will make the results known through the columns of your paper, as it is the only medium foundrymen have of exchanging opinions.

I would like to obtain information in regard to making core arbors to make green sand cores for eighth and quarter turn bends, ranging in size from 4″ to 24″ diameter.

Frank Kavanaugh.

Rusk, Texas.

Care of Machinery.

Editor American Machinist:

Did it ever strike you what little care and attention is bestowed in general to the heavy tools in shops, especially the newer ones?

The sole aim and ambition of everybody in the shop, from proprietor to "cub," is to get the new machine belted and running on highest speed about the same minute it is unloaded in front of the door. The time required to carefully wipe off the slush and get the transportation dust out of it, and give all the working parts a thorough oiling, is considered a dead loss, and of course is not indulged in.

At last the belts are on and our man has charge of the new tool. Our man having hooked his overalls up another notch, is about to throw the shifter, when the foreman happens around, and says by way of encouragement: "We expect you to bore one hundred more pulleys a day than you did on the old tool." And our man goes in to win a record, and succeeds quite well until about four o'clock, when the spindle goes on a strike for an increase in oil. About this time everybody remembers that an oil can is real handy to have around. Next day the damages are repaired, and then it is found that the carriage needs overhauling. This attended to, the work goes nobly on again, and it is discovered that the lathe won't do true, accurate work. The result is discouragement; foreman uncomfortable; proprietor worried and feeling wronged by the maker of the tool, to whom he writes a very caustic letter of complaint. All because the foreman spoke the right words to our man two days too soon, instead of turning his brains into a lubricant. Such cases happen nine times out of ten.

The new passenger locomotive, just out of the shops, is not sent out on the trip with the express, but we take her out for a week hauling slow freights, where the opportunity is given every ten miles or so to oil up and adjust the wearing parts exposed to frictional contact; and the way oil is distributed during that trial week, it would seem that we carried the tank full of it to draw from, instead of water. Then, after her probation on freight is over, the night express is coupled on, and our engineer points out a fresh mile post every minute without worrying an instant about the bearings on his machine. Now if such a course is of value to the locomotive, why should not the same rules apply to the tools that help create it?

I saw a new stationary engine started up one morning, to do the usual day's work in the factory. "That's what it's built for," said the man in charge, but I always thought he was mistaken, because they stopped before dinner with the journals cut, eccentrics cut, and several dollars cut off the firm's profits, from delay and repairs, just because the oil can was neglected at the wrong time, and a perfect disregard of care was in advance of sense. Don't be afraid of using oil and care at the start, and at the end of a week you can dispense with most of the oil and "swap" the care you started with, which contained considerable worry, for the other kind, composed of pride over the appearance and good qualities of your machine.

There is a tool maker, somewhere, that puts the word "oil" on his machines wherever needed, which is very good, but he might have added a ten-foot sign reading thus: "Total number oil holes, 32; use four times per day for two weeks, and once a day for twenty years," and then he would find that two-thirds of the users were butting their heads against that sign, with utter disregard of its advice.

Talk about "pouring oil upon the troubled waters!" I don't believe there would have been any trouble if the oil had been used in time.

W. S. Rogers.

Electrically Charged Moulds.

Editor American Machinist:

In your issue of March 24, C. W. Crawford asks for information as to what effect surrounding a flask with a powerful electro-magnet would have during the process of pouring molten iron or steel, or if additional strength or improved polarity in dynamo castings can be obtained.

Now, I can't exactly tell what effect the flask so charged would have upon the casting, but it seems to me that it would have a terrible effect upon the man engaged in pouring the molten iron or steel into a mould so charged; or, in other words, it would be a death trap, if the experiment were tried by a person not familiar with electricity.

It would be a very easy matter to connect a couple of wires to the main wires of a dynamo and wrap it about the flask so that the

current will pass through the flask and on the main wire again and to the lamps, as it were.

Now that everything is in readiness, the dynamo is started; then the flask is magnetized, and as I think dry sand is a non-conductor, the sand would have to be damp sufficiently to permit the mould to be charged with electricity; and next comes the molten iron or steel. As soon as it touches the charged mould, it becomes magnetized, then the man pouring it would come next in order to be magnetized; and I hardly think he would publish the result.

CHAS. F. BARNHURST.

Making Spiral Springs.

Editor American Machinist:

I have recently seen in the AMERICAN MACHINIST ways and means for making spiral springs enlarged at the center. I intended to make you a miniature mandrel, which I believe will do the proper thing, but have had no opportunity. I will venture a description of the same, hoping to make it clearly understood by any one interested. Taper the mandrel down both ways from the center, or give it any other form to suit the fancy. Set the lathe straight and cut a square-threaded screw from one end of the mandrel to the other. We now have a square-threaded screw with a straight core, or center of uniform size, though the outside may have the form of a neck yoke, hour glass or lamp chimney. Wind the spring wire on the top of the thread, and let it slip off the thread into the groove, and screw the spring off the mandrel. It will be well to make a shallow groove in the top surface of the thread, to guide the wire while coiling.

J. E. MCCONNELL.

Perforated Feed Pipes.

Editor American Machinist:

I notice in your April 7th number a question by H. L. H., St. Louis, which leads me to say that some people are making a big mistake and do not know it. They will tell you their pump is working much harder than when they first started their boilers on the branch pipe, spray feed in steam space. From the start the holes begin to fill up with scale. In one case a large pump was literally ruined. They put in an inspirator whose power is always 25 per cent. above boiler pressure, and it would not put the water against the pressure of any single boiler, but would do it by opening to the whole battery. I found the most of the holes in branch pipes completely filled, and on reaming them out there was no trouble to feed either or all. Now there are hundreds who are using that mode of feed, and are doing it and not knowing the cause of their trouble.

Boston. BOILER FEED.

Why was the Draftsman Discharged?

Editor American Machinist:

I see in your issue of April 7, that Mr. Gascon discharged a draftsman because he calculated the strains on a planer crosshead. I think the draftsman knew about how much the belt would pull, and could therefore easily figure out the maximum strain on the crosshead. But perhaps it was for not knowing how to do this that he was discharged; although it does not appear so from Mr. Gascon's statement. I have much sympathy with that draftsman, and would like to ask Mr. Gascon if he did not act rather hastily in this matter? J. B.

Air Pump Difficulty.

Editor American Machinist:

I have been an interested reader of the air pump difficulty. I do not think that any of the answers explain (up to date) the pump difficulty of C. A. G. I will not attempt to do so, as I am fully aware of the difference between theory and practice, as applied to air pump difficulties. But I will relate a little experience that I had. I was sent to examine a 6″ air pump that had recently been overhauled. The engineer reported that he could not obtain more than 60 to 65 lbs. of air. I made a thorough examination of the pump and pipes, and found everything in first-class condition. I then decided to test the gauge, and found, instead of 60 to 65 lbs., he had 90 to 95 lbs. of air, the gauge being that much out. I put on a gauge that was correct, and the engineer reported that the pump worked splendidly. H. S. M.

Steam Power Plant—The Ideas, Notions, and Advice Thereon, and the Liability of the Buyers and Users to be Misled Thereby.

BY WILLIAM LOWE.

SECOND PAPER.

If we leave the chimney out of the consideration of steam power plant, it would lack one of the most essential considerations, for there is no part of the plant that there is so much guessing about, and so many failures and mistakes made upon.

The cost of a proper chimney or stack is considerable, and the many failures in capacity and draft are due either to the lack of knowledge on the subject, of the party who determines it, or their disposition to sanction its reduction in cost and capacity to the lowest probability, the most unwise thing which could be done, because lack of sufficient draft results in great loss of fuel, through an unnecessary working of the fires to get the capacity, and insufficient draft to furnish sufficient oxygen to burn the fuel properly. No better investment can be made than money put into a good and sufficient capacity of chimney for steam plant. While on this subject I will call the attention of those interested to the general lack of chimney capacity in many buildings already built, and those being built, in which it is desired to, or intended to put steam boilers for either steam heating, or power, or both. The writer has been puzzled many times to decide what to do in such cases, and has had to connect two or more of the ordinary flues, or build into and enlarge flues, or set up an unsightly stack of iron, either inside or outside the building, to get sufficient draft, and in a late case had to enlarge a flue from the cellar to the top of a six-story building, to get the necessary capacity for boilers to heat the building and run the elevator, and in another late case had to insist upon a change from the architect's size to double the size. It costs but little, when building, to build a flue in any building of sufficient capacity for boilers to heat it and put power into it, if ever required, and it should always be done; for with most large buildings they are almost sure to be wanted for power uses sometime.

After the engine, boiler, and chimney comes the consideration of the injector, pump, and feed-water heater. Of the first-named there are many to choose from, and most of those which still hold a place in general use are reliable and satisfactory boiler feeders, and always feed hot water at a temperature which will not injure the boiler; but it must be remembered that the water is heated by the steam from the boiler which feeds it into the boiler.

In the pump line there is a variety of those on the belt power system, most of which are good wearing and reliable machines; but competition has somewhat interfered with the necessary reliable construction for wear and long service in some of them.

The steam pump is to be found in great variety, and all those which have become established in use are good and reliable, and worthy of confidence, and are very enduring in the wear of their several parts.

The feed-water heater is to be found in a variety of form and construction, both on the original plan of bringing the exhaust steam directly in contact with the water, and the later system of feeding the water through pipes or a coil, surrounded with the exhaust steam, and the latest plan, of heating the water in a vessel by discharging the exhaust steam (or live steam) through tubes, which pass through or into the water in the case or vessel. With the first plan there is danger of the lubricants of the engine cylinder (which are carried out by the exhaust steam) amalgamating with the feed-water, which it is brought in contact with, and passing with it into the boiler, and doing damage to it by becoming loaded with the precipitants of the water, and sinking to the bottom in lumps, which prevents the water from protecting the plates. This danger, however, is only found with high-pressure or non-condensing engines. With jet condensing engines there is not this danger, because the condensing water, if used as feed-water, is so much in excess of the feed required to the boilers generally, that but a very small and imperceptible amount of the lubricant goes with the feed-water into the boiler. With the second plan, the lubricants cannot come in contact with the feed water, but whatever is in the water goes with it into the boiler, and so it must in the first plan, together with the lubricants. With the third and latest plan the lubricants cannot contaminate the feed-water, and if the water capacity and heating surface are large enough, the first, to form a catch basin in which the water can remain long enough to deposit its impurities, and the heating surface sufficient to heat the water up to the highest temperature possible by the exhaust steam, its impurities will be largely deposited, and may be drawn from the heater by either constant and limited drawing out or periodical blowing out; but it must be remembered that no heater upon this principle, in which there is not sufficient water capacity, can be a purifier to the extent possible, because the water will be rushed through it, and although the impurities may be separated from the water there will not be time nor space to deposit them, and therefore they will go with the waste into the boiler.

We now come to the consideration of the economy of fuel to be obtained by the feeding, heating, and purifying the feed-water in the several customary ways above mentioned. The makers and advocates of the injector claim that its use is as economical of fuel as any other way, and very convenient. The belt pump makers and advocates claim that the least power is required to feed the boiler in this way, and the steam pump makers and advocates say that this is the most reliable and convenient way, and as economical of fuel as any other. The comparison may be made as follows: The steam pump can be run at a speed that will constantly supply the boiler with the amount of feed-water required, but the injector and belt pump must be apportioned in speed and size as near the requirement as may be to give as near constant feed as possible (some allowance being made in capacity for wear and falling off), and as a constant feed is more economical of fuel than a desultory one, the advantage is in favor of the steam pump, and this advantage is carried to the heating and purifying of the feed water in a heater for the same reason, although a plunger pump may be varied somewhat in the amount of water discharged by lessening the supply to it, but the working will not be as smooth and satisfactory as the steam pump. The injector may be used in connection with a feed-water heater and purifier, and the temperature of the water, passing the injector to the heater, may be raised therein to 208° or 212° and purified therein; but the economy of fuel due that increase by the exhaust steam will be very small, as compared with heating the feed water entirely by the exhaust steam, and using either the steam or belt pump, because in this way the increase in temperature of the feed-water from natural temperature is all obtained from the exhaust steam, and may be considered clear gain. If the difference in cost of power to operate any of the feeders is considered, the advantage must be accorded to the belt pump, as requiring the least expenditure of power; but its desultory feed, as compared with the steam pump, may put the steam pump of good proportion and in good order upon an equal footing as to power expended in feeding boilers. Therefore, it is undoubtedly the most economical of fuel to feed boilers with either belt or steam pumps of close proportions, and feed through the latest system of feed-water heaters of large water and heating surface capacity, with any kind and quality of water, the water to be heated entirely by the exhaust steam, without contact from either a non-condensing (commonly known as a high-pressure engine) or condensing engine, and applied to either or both.

An applicable comparison of the difference in effect between feeding with an injector, or a belt pump, both feeding through a heater, was found in a foundry where the boiler was being fed with a belt pump, and barely able to make steam enough to run the blower to melt the iron in the furnace, and an injector was recommended to improve the steaming capacity of the boiler, and the writer being consulted thereon, decided that it would make the case worse; but the injector was tried, and resulted in the failure of the boiler to supply the steam to run off the charge in the furnace, and the bottom of the furnace had to be dropped, which came very near setting the foundry on fire; thus proving most forcibly the advantage the pump had over the injector. In a fully equipped steam power plant there should be both an injector, and either a belt or steam pump, because when the engine is stopped there is no exhaust steam to heat the feed-water, fed by the steam pump, but the injector will feed hot water, which will not injure the boiler, and the cold water from a steam pump might injure the boiler. Again, if the pump or heater get out of order and must be repaired, the injector is the safest thing to feed the boiler while such repairs are made; but if there was an internal feed pipe in the boiler to feed the water through, in such case the steam pump might be used to feed the boiler with safety, but it is advisable to have injector also, for reasons above stated.

There are several other conditions connected with the economy of fuel in a steam power plant, through the heating and purifying the feed-water, by the use of the exhaust steam; such as the use of all the exhaust steam for heating the building and for manufacturing purposes, and using an injector or pump and heating the feed-water with steam drawn from the boiler, or by feeding it through an internal feed pipe, and the difference in cost in power of feeding it to the boiler by injector power, or steam pump. On these points the writer's experience is, that the greatest effect from the fuel, in a steam power plant, is obtained by heating and purifying any water to be fed to the boiler by the exhaust steam from the engine, and with an engine of such capacity, proportion and principle as will get the most useful effect from the steam in its application to the work to be done, and a boiler of such proportion, principle and application to the evaporation required, as will produce the greatest evaporation possible from the fuel, and a chimney with sufficient surplus draft to burn the fuel with the most effect, controlled by a reliable steam pressure damper regulator, all in charge of an experienced and honest stationary steam power plant engineer.

There is again talk of erecting, in New York city, a monument to Peter Cooper. By all means let this be done. But if the effort should fail, as many such efforts do, it is a satisfaction to know that when he erected and endowed the institute that bears his name, he built a grander monument than any that will hereafter be erected to his memory.

The women are claiming, and with a good deal of reason, we think, that they should take part in the inspection of mills and factories. For weeding out children too young under the law to work in such places, and for detecting abuses in factories where women and girls are employed, they would probably be superior to the sterner sex.

The coal barons have again met and determined how much coal shall be mined during the year 1888. Of course, there is no conspiracy in this. The inhabitants of the country freeze or keep warm by the grace of a few men who own the coal. Who shall say they must operate their mines at all if they do not choose to do so?

According to insurance statistics, more fires are extinguished by the use of water pails than by all other means. The moral seems to be—keep the fire pails filled, and handy.

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NEW YORK, APRIL 21, 1888.

CONTENTS.

	PAGE.
A Large Screw Machine	1
Six-Foot Planing Machine	1
Compound Engines. By W. H. Booth	2
Foundry Cupolas. By Robert E. Masters.	2
Vertical Drills—Their Construction and Uses. By John J. Grant	3
Design, Construction, Repairs and Management of Marine Steam Engines and Boilers. By W. H. Hoffman. Third Paper	3
Practical Drawing. By J. G. A. Meyer. Forty-eighth Paper	4, 5
Another Iron Workers' Society	5
The Curtis Damper Regulator	5
Notes on British Shop Practice. By A. G. Brown	5, 6
New Building for Mechanical Engineering Department of Vanderbilt University	6
Letters from Practical Men: The "Texas" Skim Gate. By Frank Kavanaugh—Care of Machinery. By W. S. Rogers—Electrically Charged Moulds. By Chas. F. Barnhurst—Making Spiral Springs. By J. E. McConnell—Perforated Feed Pipes. By Boiler Feed—Why Was the Draftsman Discharged? By J. B.—Air Pump Difficulty. By H. S. M.	6, 7
Steam Power Plant—The Ideas, Notions and Advice Thereon, and the Liability of Buyers and Users to be Misled Thereby. By William Lowe. Second Paper.	7
Patents	8
The Struggle for Naval Supremacy	8
Literary Notes	8
Questions and Answers	8, 9
Manufactures	9
Machinists' Supplies and Iron	10

Patents.

When a man secures a patent from the United States Government for, let us say, some mechanical device, he must, by drawings and specifications, make the whole matter so clear that one "skilled in the art" can make and operate his device. This is important, because the patent is nothing more nor less than a contract between the individual and the public, represented by the Government. By the terms of this contract the public agrees that the individual shall have, for a term of years, the advantages of his skill as an inventor, after that time the advantages going to the public. This is not a fair statement of the case from the inventor's side, because it is certain that if the invention comes into use during the lifetime of the patent, it can only do so for the reason that it represents something that is wanted; something that the people are, or think they are, better off for having. But, letting the statement stand as it is, it is essential that the construction and operation of the device be described so completely that any one with fair skill can comprehend it. This is something that the public has a right to insist upon—something in which the Patent Office is frequently remiss.

Drawings and specifications should be so complete that individuals may have, as nearly as possible, equal advantages in the patent when the protection accorded to the individual ceases. It must not be forgotten that the patent laws are intended to benefit the public, and only incidentally the inventor. In this respect the patentee is put to a disadvantage that the wordy declaimers against "patent monopoly" never, apparently, think of.

The wisdom of offering some inducement to inventors is beyond question. A man would be a being of phenomenal disinterestedness who would spend his time in devising something for others to use. When mortals become perfect it will be time enough to calculate that they will use their brains and time for motives purely unselfish. On the other hand, restricting the time in which the inventor shall enjoy a monopoly of even his own creation is wise. There is, in the first place, a fair incentive to hard work on the part of the inventor; some chance for making money out of what he does. And in the second place, the public gets most of the advantages of the invention while the patent is in force, and in the course of a few years the invention belongs entirely to the public, the inventor being prevented from enjoying a lengthy monopoly of what he has brought into existence. And such a monopoly as he does enjoy is the result of directly benefiting the public by offering to sell them something they could not buy but for him.

There is yet another reason why drawings and specifications should be complete. That is, that other inventors in the same line may be able to test the value of the patented device, or determine whether or not it will work as described. This any one has a right to do. A patent cannot be made to cover something that is not shown or described, or a combination of certain parts to accomplish a certain purpose that they will not accomplish. But the distinction is sharp between making a patented article for the purpose of determining whether or not it will work as described — for experimental purposes—and making the same article to use for practical purposes, as intended by the inventor. We mention this because, judging from the letters we receive on the subject, there is a good deal of misunderstanding in regard to it.

One of the most common objections urged against the granting of patents is the almost interminable lawsuits often brought about. It is difficult to see what this has to do with the subject. No sensible man would think of making of the Patent Office a court of last resort. Long lawsuits often result from disputes over the title to land, and other forms of property not covered by patents. That a title from the Patent Office should sometimes be open to litigation is no more remarkable than that a deed of land or other property should sometimes be disputed.

A patent may be used to a bad end, just as fire or water may be so used. And those who hope to entirely avoid this are likely to find themselves mistaken. Any legislation that shall materially abridge the rights of the inventor is sure to work damage. The patent laws are very good as they are, and should be "improved" with great caution.

The Struggle for Naval Supremacy.

The struggle between the European nations for naval supremacy still goes on, with France apparently in the lead just at present, though how long she will maintain her lead it is difficult to say.

It has heretofore been supposed that the nation which possessed a navy decidedly stronger than that of any other nation had done all that could be expected for its protection, and was reasonably safe in case of attack; but now comes an English admiral who calls attention to the alarming fact that the English navy is not nearly so strong as certain naval combinations which might be brought against it. He points out that there is a possibility of a Franco-Italian, or a Franco-Russian, or a Franco-German alliance against Great Britain, either of which combinations would be able to bring a superior naval force into the contest.

Although it is not distinctly stated, yet the inference is, that in the opinion of this admiral, the navy of England should at once be strengthened to make it superior to any of these combinations. But if the combinations mentioned are possible, then why are not combinations of the combinations also possible, in which case it might be necessary to prepare for a contest with a Franco-Italio-Russio-German alliance. This would make a good-sized navy, and keep quite a number of workmen busy for some time in constructing it. Then if France should conclude to have a navy stronger than the navies of all other nations combined, including England's—but we desist; at that rate there would soon be a lack of room on the high seas in which to float the navies, and no time or money to do anything else but build them.

The manufacturer who delivers exactly what he sells is the one who will win in the end. And these are the ones, and the only ones, who build up an enduring, solid business. There is no doubt, sometimes, strong temptation to overrate goods—machinery, for example—but it never pays to do so. The man who buys a machine that does not do as well as it is recommended to do is always dissatisfied, no matter if it is better than anything of the kind he ever saw before. He is a dissatisfied customer, and his dissatisfaction is likely to carry him elsewhere to buy next time. If the same machine does as well, or a little better than recommended—if it is not overrated for the purpose of making the sale—the buyer is satisfied, his satisfaction insures his custom in the future, and is reasonably sure to influence other customers. Many good things fail to work their way into public favor because their utility is enormously overrated. If a saving of 10 per cent. is guaranteed and obtained the transaction is in every way satisfactory. If a saving of 50 per cent. is guaranteed and 20 obtained there is dissatisfaction.

New York is a large and growing city, and it is natural to look for growth in everything that goes to make up a great city. Yet one of the best authorities on such subjects shows conclusively that in the matter of real, unadulterated, high-toned first society inhabitants, there are but four hundred in all this great city. It is a wonderful falling off, and quite unexplainable. Of course, when a man or woman comes to the point of doing something useful in the world, his or her standing in society is destroyed. But are we to think that men and women are turning to something useful more than ever before?

Literary Notes.

A TREATISE ON THE USE OF BELTING FOR THE TRANSMISSION OF POWER. By John H. Cooper, Mechanical Engineer. Third edition, with much additional matter. Philadelphia: Edward Meeks, 1012 Market street. Price, $3.50.

This work is in need of no commendation; it is considered as a standard treatise on the subject. It is plainly written, well illustrated, and should be in the hands of every mechanic and engineer interested in driving by belts. It is a large book of 400 pages, and covers the ground most completely and satisfactorily.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(201) J. F. G., Chanute, Kan., asks: 1. Is there anything through which an ordinary magnet will not exert its force? *A.*—Not that we are aware of. 2. If a magnet be made of hollow steel with the ends closed up solid, would it have as much power as it would if made of solid steel? *A.*—No.

(202) B. A., Madison, Wis., asks: 1. Why do not all locomotives have water glass gauges? *A.*—Locomotive engineers generally prefer the try cocks, and as they always stand in position to use them, do not generally care for the glass line, which they would not trust, anyhow. They can use the cocks in the dark, when they could not see the glass. 2. It is claimed by some railroad men that the tires of driving wheels on the right-hand side of an engine wear faster than those on the left. Is this so? *A.*—No.

(203) F. C., Newnan, Ga., writes: 1. We are to put in new boilers, 60 inches by 14 feet. There are two locations respectively 20 and 42 feet away from engine. The position 42 feet away is preferable. Can we cover this pipe so steam will come to engine dry, and what will be the loss in pressure? *A.*—There will be no trouble whatever if pipes are properly covered. If pipe is large enough there will be no loss of pressure of consequence. 2. For 150 horse-power would it be advisable to use compound engines for a cotton mill? *A.*—Yes.

(204) R. S., Terre Haute, Ind., asks: 1. Why is a saddle pin on a link for a locomotive always put a certain distance out of the link center toward the eccentric rods? Is there a rule for finding the position of the saddle pin on the link? *A.*—The saddle pin is moved out of the center of the link for the purpose of equalizing the cut-off. The method for finding the position of the pin you will find explained in a series of articles which have appeared in the American Machinist, May 10, 17, 24, 31, 1884. 2. Is there any book on the construction of the link? *A.*—You will find the construction of the link explained in the series of articles on Modern Locomotive Construction now running in the American Machinist.

(205) H., Danville, Pa., asks: Will you kindly tell me how I may temper steel springs in disk form, say 1¼ inch diameter, ¾ inch hole in center and 1-32 thick? Of course I can temper in the usual way, in oil or hot water, or both, but this is too slow for my purpose, as I want to make them by the thousand. *A.*—You can heat them in a lead bath and quench them in water or oil. The temper can be drawn in a vessel containing oil covered to prevent ignition, into which a thermometer may be introduced. They should be put into a perforated pan or vessel and let down into the oil, then the oil should be covered and the heat raised to the desired point, or they may be put into a vessel containing fine sand and shaken over a fire until the proper temperature is reached.

(206) F. G., Brantford, Canada, writes: We are running a 14" x 36' Brown automatic cut-off engine. When the engine was made we had in view that at some future time we would require to increase our power, and had the shaft and fly wheel made so at any time we could attach another engine to the other end of engine shaft. That time has now arrived, and we are told by some parties that, if we would put a 25" x 36" cylinder on the other side of the present engine, and run the exhaust steam from the 14" x 36" into the 25" x 36", and use a condenser, we would double our power with the same steam and fuel that we are now using. Would such an arrangement as described above work satisfactorily, or do you know of any parties that are using anything similar? *A.*—The arrangement you speak of would be making of your engine a compound engine in a way quite common in this country. If you have the work done by some one who has had experience in such work you should get very satisfactory results, and a large saving in steam over non-condensing engines.

(207) W. C., Erie, Pa., writes: There are four stay bolts 6 inches apart, each stay bolt is 1 inch in diameter, steam pressure 100 pounds per square inch. Please give rule for finding the exact pressure on the stay bolts. *A.*—Multiply the distance from center to center of stay bolts measured lengthways by the distance from center to center of stay bolts measured crosswise and by the pressure per square inch, the product will be the total pressure which each stay bolt has to resist. Hence, the total pressure which each stay bolt has to resist in your example will be 6 × 6 ×

100 = 3,600 pounds. To be very exact, the area of the stay bolt multiplied by the steam pressure per square inch should be deducted from the 3,600 pounds, but this is generally neglected. If now the cross-sectional area of the bolt is exactly one square inch we would say the tensile stress per square inch is 3,600 pounds. If the area of the bolt is more or less, we divide the total stress on the bolt by its area, the quotient will be the tensile stress per square inch. The area of one inch is equal to .7854 square inch, hence the stress per square inch is

$$\frac{3600}{.7854} = 4583.6 + \text{pounds}$$

per square inch.

(208) J. M. T., Pulaski, Tenn., asks: How can I drill a hole in agate or a small marble? *A.*—Instead of a drill use a copper rod or wire, and feed it with emery and oil.

(209) J. L. C., Racine, Wis., asks: 1. What is the comparative value of phosphor bronze, carbon bronze and brass for journal boxes? *A.*—By brass we presume you mean the usual mixtures of copper, tin, etc, used for boxes. There is no way of making a comparison. Some engineers prefer one, some another, according to place. 2. What is the expansion of these metals between 32° and 212°? *A.*—The expansion of all is substantially alike. See AMERICAN MACHINIST of April 30, 1887.

(210) S. S., Hudson, Mass., asks: 1. In Mr. Booth's third paper on compound engines he gives the constants as 5.266 and 16.175. How does he get these? *A.*—From one pound mean effective pressure. 2. In belting vertically from an 18" to an 8" pulley does it, other conditions being equal, make any difference whether the driving shaft is above or below? *A.*—But little, if any. Assuming that the belt will be a little more likely to slip on the small pulley, if you belt from below you will get some help from the weight of the belt.

(211) O. I. W., Ottumwa, Iowa, writes: We have an artesian well here, sunk by the Ottumwa Development Company, as a public enterprise. It is 1,500 feet deep, has a flow of 1,200,000 gallons daily and a pressure at the earth's surface of 41 pounds to the square inch. About what horse-power would it furnish? *A.*—The actual horse-power of the water as it flows to the surface is about 20 horse-power. The effective horse-power to be obtained from this depends upon the kind of machinery used, and the distance from the well at which the pressure is utilized.

(212) H. J. M., Chicago, Ill., asks: Can a plain slide valve engine, 16" x 22", taking steam full stroke, running with a 7 inch pulley on governor and making 120 revolutions, be changed by changing the valve to cut-off at half stroke, and changing governor pulley to 9 inches diameter, the engine still running 120 revolutions per minute? *A.*—Changing the point of cut-off does not necessarily call for any change whatever in size of governor pulleys. The governor pulleys are presumably right for 120 revolutions per minute; their size is not determined with any reference to point of cut-off.

(213) G. H. C., Belleville, N. J., writes: We have a gasolene tank which we use for heating our ironing machines, sixteen in number, and as soon as cold weather sets in, we have trouble from the gasolene freezing in the pipes on the float in the tank where the pipes enter the gasolene from the blower. The tank is situated 50 feet from the building; it is 4 feet by 4 feet, and we use 208 gallons at a time. The gas is made from a blower No. 00 Sturtevant, running at 2,000 revolutions per minute with 3 inch discharge. What I would like to know is, how to overcome this freezing in the tank? *A.*—The very fact that you have trouble only when cold weather sets in, seems to indicate that the pipes and tank are not sufficiently protected from the cold. Without seeing your apparatus, and with the small amount of data you have furnished us, we cannot advise you exactly what to do. We should call in the makers of the apparatus, and let them remedy the trouble.

(214) Machinist, Camden, N. J., writes: There is an old lathe in the shop on which you have to change the gear on the stud, the two gears on the intermediate stud, and the gear on lead screw, in order to cut a desired thread (all four gears have to be of a certain number of teeth). The spindle runs twice as fast as the stud. Please tell me the rule for finding the gears on such a lathe. *A.*—You will find a rule in the answer to Question 15, in our issue of Jan 14, 1888. 2. Suppose a cannon is placed upon a train moving at the rate of a mile a minute. The cannon has the force to throw a ball at the same rate of speed. The cannon is discharged in an opposite direction from which the train is moving. Does the ball move? *A.*—No, the momentum imparted to the ball by the motion of the train is just overcome by the force of the powder, and it will fall to the ground at the point of discharge. 3. Which is the correct term to use in speaking of the projections on the face of a gear, cogs or teeth? *A.*—The terms are used indiscriminately, but the term cog is more properly applied to wooden teeth which are inserted in a wheel.

(215) A. R. H. and A. J. H., New York, send a sketch and ask: The two hot-wells (on board of steamer) are the same form below the line *A*, above it they are different. The area of the delivery valve *B* is the same in both cases. The condenser is a jet and the discharge while running continuous. The question is, which style of hot-well requires the most work from the air pump, and which gives most strain on the valve *B*. X advocates the hot-well shown by the full lines; Y that shown by the dotted lines. The discharge through the vessel's side in X's plan is one foot above the discharge in Y's. The volume of water in X's plan in the well itself, not counting the pipe, is about one-half of the volume of Y's. *A.*—The pressure on the valve *B* depends upon the vertical distance from the valve *B* to the discharge in the side of the vessel, and not on the volume in the hot-well. As the vertical distance from the valve *B* to the discharge in the side of the vessel is increased, the pressure on the valve *B* will also be increased; and since this vertical distance in X's plan is greater than that in Y's plan, it follows that pressure on the valve *B* will be greater, and consequently will give more strain on the air pump in X's than in Y's plan. Again, since the same amount of water is discharged in both cases, and since in X's plan this amount of water has to be lifted through a greater distance, the air pump will do more work in X's plan.

(216) B. D. W., Fargo, D. T., writes: A portion of the city water system is arranged as follows: From the pumps a 12 inch main extends 900 feet, with 30 feet elevation from pumps and connects into a 12 inch T branching at right angles both ways, runs 600 feet, at which point an 8 inch pipe is connected by a T and continues 400 feet, at which point is hydrant No. 1—100 feet further is hydrant No. 2—20 feet from No. 2 a 6 inch pipe is taken from the 8 inch pipe and runs 300 feet to hydrant No. 3. Now, from hydrant No. 1, 250 feet of 22 inch hose is laid and a smooth fire nozzle 1 inch inside diameter attached. From hydrant No. 2 two lines are laid, each 500 feet long, with 1 inch nozzles; from hydrant No. 3 two lines were laid, one 300 feet, one 150 feet with 1 inch nozzle. Hydrants 4 inch connection to mains, connections 8 feet from main to base of hydrants. The system is supplied by direct pumping pressure. What would be the approximate pressure at nozzles and delivery at nozzles per hour, also delivery during 5½ hours? Pressure at pumping station 115 pounds. *A.*—It is difficult, if not wholly impossible, to determine the exact amount of friction in the pipes and hose. Leaving the friction out of consideration, the total discharge through all the five nozzles will be 82,800 gallons per hour: and 455,400 gallons in 5½ hours. In order to determine the actual number of gallons discharged we believe it is perfectly safe to deduct 25 per cent. from the figures given. The pressure at the nozzles will probably not exceed 75 pounds per square inch.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Gear Wheels. See adv., page 16.

Link-Belting.
Send for catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Machinery Co., Chicago and N. Y.

Taper atttachment on all lathes Lodge, Davis & Co.
Compound rest on all lathes Lodge, Davis & Co.
Power cross-feed on all lathes Lodge, Davis & Co.
Large hollow spindle on all lathes Lodge, Davis & Co.
Automatic stop on all lathes Lodge, Davis & Co.
See special ads. pages 15 and 16, Lodge, Davis & Co.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb Knitting Machine Co., Chicopee Falls, Mass.

Machine work and pattern making. Anderson Machine Works, Peekskill, N. Y.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Pattern and Brand Letters. Vanderburgh, Wells & Co., 56 Beekman street, New York.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Light and fine machinery to order; foot lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

For first-class automatic engines write to Williams Engine Co., 447 North street, Baltimore, Md.

Burnham's turbine wheel is sold at net price to mill owners. Catalogue free. Address York, Pa.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Silk wiping towels are better and cheaper than waste. S. A. Smith, 23 South Canal st., Chicago. Ill.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Robertson's damper regulator; no diaphragms, springs or packing; the cheapest good regulator in market. Hine & Robertson, 45 Cortlandt st., N. Y.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See April 14, p 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Machinists' supplies, brass goods, m'f'rs supplies, polishing materials, all kinds wire, metals, etc., in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

James D. Cardell & Co., 1900 Passyunk ave., Philadelphia, Pa., manufacturers of boilers and tanks, make a specialty of coils of wrought-iron pipe for ice machines, blast furnaces, door frames, heaters, dye houses, etc.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

Patent Att'y. R. G. DuBois, 916 F. st., Washington D. C. Reliable service at reasonable rates. Send for 38-page pamphlet containing list of references.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

New book on gears; ask dealers in books and machinists' fine tools to send for one, or send for one yourself by P. O. note. Price, 50 cents. Address Chas. B. Long, M. E., Worcester, Mass.

Randall's copper-tipped hammers are something that every machinist should have; ask your dealer to show you one, and if he does not keep them, write to Montgomery & Co., 105 Fulton st., N. Y.

W. H. Hoffman, consulting engineer, 94 Liberty st., N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Parties requiring milling machine or screw machine work furnished, in large or small quantities, will please write to the manufacturers, E. E. Garvin & Co, 139, 141, 143 Centre st., New York City.

The Dieble Mfg. Co., Philadelphia, Pa., mfrs. of the Challenge emery grinding and polishing machinery, invite correspondence with all needing this class of machinery. Catalogues and prices on application.

Hot Water Supply. A practical treatise on the fitting of hot water apparatus for domestic and general purposes. By F. Dye. 82 pages, with 25 illustrations. 12mo., cloth, $1. Send for catalogue. E. & F. N. Spon, 12 Cortlandt street, N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G Co., 96 Fulton st, New York.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including April 7, 1888 issue 47 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING Co., 96 Fulton street. New York.

"Modern Locomotive Construction," by J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 61 articles have thus far appeared up to and including the March 31, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING Co., 96 Fulton st., New York.

MANUFACTURES.

Findley & Fields will build a machine shop at Dalton, Ga.

Geo. W. Boling expects to build a planing mill at Anniston, Ala.

A. F. Buzzell is interested in building a foundry at Laurinburg, N. C.

I. T. Moore expects to erect a spoke and handle factory at Creswell, Ga.

Thomas & Gordon will erect an electric light plant at Beaumont, Texas.

Reynolds & Baker propose to enlarge their iron foundry at Bristol, Tenn.

Whittle & Hand will rebuild their wood-working factory at Georgetown, Texas.

George A. Watson is interested in building a furniture factory at Danville, Va.

James B. Lanier will double the capacity of his machine shop at Salisbury, N. C.

The Bessemer Machine Co. will build a machine shop and foundry at Bessemer, Ala.

The Meriden (Conn.) Bronze Co. are erecting an addition to their works 40×250 feet.

The Chesapeake & Ohio Railroad Co. will enlarge their machine shops at Paducah, Ky.

The Board of Public Works of Little Rock, Ark., propose to erect an electric light plant.

The Fort Worth and Denver City Railroad Co. will build a machine shop at Clarendon, Texas.

The Sheffield & Birmingham Coal, Iron and Railroad Co. propose building machine shops at Sheffield, Ala.

The Little Rock & Alexander Railroad Co. will build a roundhouse and machine shop at Little Rock, Ark.

The South Florida Electric Light, Power and Motor Co. has been organized to operate at Kissimmee, Fla.

The Deane Steam Pump Co., Holyoke, Mass., are putting in a new pump for the water-works at Anniston, Ala.

The Binghamton (N. Y.) Hoe and Tool Co. will remove to Birmingham, Ala., and be known as the Birmingham Mfg. Co.

The Gulf, Colorado and Santa Fe Railroad Co. will rebuild their machine shop at Cleburne, Texas, recently destroyed by fire.

Recent additions to the boiler works of Borger Bros., Columbus, Ohio, make their shops 50 x 111 feet, the largest in Columbus.

The Elowah Furniture Factory Co. expect to increase the capacity of their factory at Rome, Ga., having increased their capital stock.

The Pittsburgh Steel Casting Company, Pittsburgh, Pa., recently made a casting of a gear wheel for the water-works at Toronto, Canada, which weighed 9 tons.

J. H. Adams, Warren, Mass., has been engaged in erecting a pumping engine, built by Knowles Steam Pump Co., Boston and New York, for the water-works at Waco, Texas.

The Springfield (Ohio) Machine Tool Company write us: We have increased our plant by adding two engine lathes, one bench lathe and one drill press. All our tools are kept busy, and working to good advantage.

The City of Cincinnati has contracted with The Laidlaw & Dunn Company, of that city, for two Galloway boilers, 7 feet by 28 feet, with a 48 inch by 150 feet chimney, to furnish 600 horse-power for their water-works. The amount of contract is about $11,000.

The Detroit (Mich.) Copper and Brass Rolling Mills have just finished very complete works. The main building is 134 x 474 feet, the brass casting shop is 30 x 100 feet, and the boiler and engine house is 80 x 100 feet. The works will, when running full, employ 300 men.

The Windisch-Muhlhauser Brewing Co., Cincinnati, Ohio, are extending their plant, and expect soon to have not only the largest, but the finest brewery in the world. They have placed orders with the Reliance Gauge Co., Cleveland, Ohio, for safety water columns for their boilers.

The Page Belting Company, Concord, N. H., have lately received a large order from Japan for a lot of their "Hercules Raw Hide" belting. Their prospects of trade in that country are very flattering. Within a week they have received inquiries for prices on their goods from St. Petersburg, Russia, and Alexandria, Egypt.

J. E. Lonergan & Co., Philadelphia, Pa., have issued an 1888 catalogue. It is finely illustrated, and shows and describes a great variety of lubricators for stationary, locomotive and marine engines. We notice a new "snifter valve" for steam engine cylinders, which can be used as a relief valve and cylinder cock, all in one.

All the buildings and machinery of the Nashville (Tenn.) rolling mill have been purchased by the Elyton Land Company, Birmingham, and the entire plant will be moved there at once. The capacity of the mill is seventy tons per day, and 500 men will be employed. The mill was built by Cherry, Morrow & Co., of Nashville, but they found they could not operate it profitably in that city, and sold it very cheap.—*The Tradesman.*

A testing laboratory has been opened by the University of Illinois, at Champaign. The laboratory is equipped with a testing machine of 100,000 pounds' capacity, having attachments for tensile, compressive and transverse tests; also a mercury column for testing gauges up to 215 pounds per square inch. The university issue a schedule of prices for making tests, with proper sizes and forms of test pieces.

The Waterhouse Electric and Manufacturing Company organized at Hartford, Conn., about two years ago and started in a small way, and in a small room, in Colt's Armory. At the present time they are occupying half the second floor of that large building, and part of the first floor. They manufacture dynamos and lamps for arc and incandescent lighting. Their systems of lighting, both for out-door and factory plants are highly commended.

The Miller Forge Company, Limited [Pittsburgh, Pa.], have received an order for an iron shaft for one of the large tow-boats belonging to the trade between this city and the lower river ports. This, of course, would be nothing unusual in itself were it not for the fact that the same boat has broken three steel shafts, and its owners have concluded to go back to a shaft made of Pittsburgh refined iron. This is not the only instance of the kind, and the question is therefore brought forward, which is the better material for steamboat shafts, steel or good wrought iron?—*American Manufacturer.*

The M. C. Bullock Manufacturing Co., of Chicago, manufacturers of milling and mining machinery, report the following among recent important shipments: To C. J. Johnson, Dell Rapids, Dakota, one 3½" quarry drill outfit and boiler; to the Chapin Exploring Co., Tower, Minn., one duplex mining pump and boiler; to the Locey Coal Mine, Loceyville, Ill., one first motion hoisting plant, consisting of two 18×24 link motion horizontal engines, with one 5×7 drum; to the Central Coal Co., Springfield, Ill., two 18×24 link motion horizontal engines; one 6×7 wood-lagged drum; two coal mine cages; two 6-ft. sheaves; one fan, and one 9×14 engine; to W. W. Robbins, San Antonio, Texas, one "Crescent" diamond prospecting drill outfit; to George M. Wakefield, Llano, Texas, one deep-hole "Dauntless" diamond drill outfit, complete.

A new machine for the rapid manufacture of wooden conveyor flights has been designed by Mr. C. L. Redfield, of Redfield & Haberlin, mechanical engineers, Minneapolis, Minn. This machine performs every operation automatically, from receiving the rough strips of wood to dropping out the finished flights. Heretofore this work has been done by six or eight handlings on as many different machines. This machine has recently been put into operation and delivers the finished flights at the rate of from 20 to 30 per minute. An important advantage of the new machine is that the flights are much better finished than by the old process. As the machine is comparatively small, not likely to get out of order and requires but one attendant, it seems destined to supersede present methods of manufacturing flights.

Machinists' Supplies and Iron.

New York, April 5, 1888.

Iron—American Pig—We quote Standard Lehigh brands $20 to $20.50 for No. 1 X Foundry, with outside brands at $20 to $20.50; No. 2 Foundry is quoted at $19 to $19.50 for Standard Lehigh brands, with others obtainable at $18 to $18.50, and Grey Forge ranges from $16 to $16.50

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to sell planes, see page eleven.

Wanted—Position as draftsman; best references. Box 92, American Machinist.

Wanted—Position as foreman pattern maker; best references. Box 91, American Machinist.

An experienced mechanical draftsman wants a position. Address Plm., Am. Machinist.

Wanted—Situation as machinist, by young German just arrived. Box 93, American Machinist.

Wanted—In Philadelphia, a good mechanical draftsman. Address K. W., Am. Machinist.

Wanted—A few first-class machinists; only skillful men need apply. 151 Cedar street, N. Y. City.

Wanted—Foreman machinist for new work and repairs; 30 machinists employed. Box 94, Am. Mach.

A draftsman employed in the mining regions of Penna. would like to go South. Address South, Am. Machinist.

A mechanical draftsman, experienced on machine tools and special machinery, wishes position; shop experience; best references. H. O., Am. Mach.

A practical engineer and draftsman wishes position; good references. Vicinity of New York or Boston preferred. Box 95, American Machinist.

Situation wanted as master mechanic or erector, by experienced man, on all kinds of heavy machinery; first-class refs. Address C. T., Am. Machinist.

Wanted—Draftsman on printing machinery; permanent employment if satisfactory. Address, Golding & Co., Boston, stating age, experience and pay required.

Wanted—A young man with some experience in brass working, to assist a brass pattern and model maker. Apply at factory of The Springer Torsion Balance Co., 147 Eighth street, Jersey City, N. J.

Wanted—Foreman for blacksmith shop. Must be thoroughly up to die and tinner's stake forging, steel melting, etc. A first class opportunity for the right party. Address Niagara Stamping & Tool Co., Buffalo, N. Y.

Situation wanted in New York or Brooklyn by draftsman. Marine engine or general work preferred. Graduate Stevens Institute. Two years' experience in shops; 1½ years in drafting room. H. P. A., Am. Machinist.

Draftsman—A practical man with some experience at drawing and a technical education wants a position where he can be under a good mech. engineer. and get valuable experience as well as moderate pay. Address R. D., Am. Machinist.

Wanted—A position as superintendent or foreman by a young man who is a first-class machinist and tool maker, also a good draftsman, and has had large experience in general machine shop practice; a systematic and economical manager of men; best of reference S., Am. Machinist.

Wanted—A party to act as superintendent, with $10,000 to invest in a prosperous Western manufacturing plant, and take an active interest in the business on a fair salary; must be a practical machinist and one with experience in steam machinery preferred; paid-up capital, $50,000, with $10,000 surplus. Address Capital, Am. Machinist.

Wanted—Foreman for a large foundry in North Alabama; also foreman for pattern shop, and bookkeeper for the works. The capital stock of the company is one hundred thousand dollars, and the works in active operation. Each person will be required to take from 3,000 to 5,000 stock in the company. Address P. O. Box P, New Decatur, Ala.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent steel tube scrapers are unquestionably the best. Crescent Mfg. Co., Cleveland, Ohio.

Crescent boiler tube cutter, for setting new and removing old tubes. Crescent Mfg. Co., Cleveland, O.

Wanted—Parties having machinery specialties to build, to correspond with. Box 75, Am. Machinist.

Hard rubber blowing and pressing dies and machinery a specialty. E. O. Chase, Newark, N. J.

Any parties having machinery adapted to making a simple, direct-acting steam pump, and desiring to build standard work, can address Y. Z., Am. Machinist.

Wanted—Specialties in light machinery, hardware and novelties in the hardware line, to manufacture for the Canadian market on royalty, or by contract. Address, Box 595, Ingersoll, Ont., Can.

A. C. Christensen, 26 Church st., N. Y., mech. and hydraulic engineer. Prepares designs of waterworks pumping stations, drawings of steam pumps, pumping engines, gen. mach'ry and pat. drawings.

THE CAMPBELL MACHINE CO.

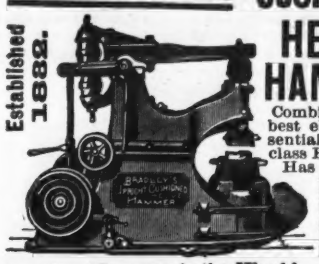
is very thoroughly equipped to do first-class machinist work, in experimenting, model making, and the building of all kinds of fine light Machinery and Tools.

Superior Workmanship at Reasonable Prices.

Address CAMPBELL MACHINE CO.,

PAWTUCKET, R. I.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER



Established 1832.

Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other Hammer in the World.

Bradley's HEATING FORGES

Established 1832

Pat. Aug. 30, 1887

With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements.

For hard coal or coke. Indispensable in all shops to keep Bradley's Cushioned Hammers and men fully employed and reduces cost of production.

BRADLEY & CO., Syracuse, N. Y.

STEPHENS PATENT VISES.

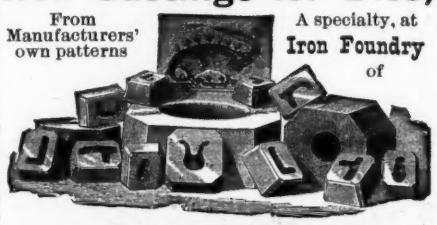
ONE HALF TIME and LABOR saved by using this solid, strong, durable, firm hold, quick-working Lever (Not Screw) Vise. Has improved Taper Pipe and other attachments. Sold by the trade. Send for circular.

TOWER & LYON,
95 Chambers Street, New York.
Successors to Melvin Stephens.

Iron Castings for Dies,

From Manufacturers' own patterns

A specialty, at Iron Foundry of



T. SHRIVER & CO.,

333 EAST 56th ST., N. Y. CITY.

Castings with nice surface and fine detail, for manufacturers of Silver Ware, Cane and Umbrella Handles, &c., &c. For information address as above.

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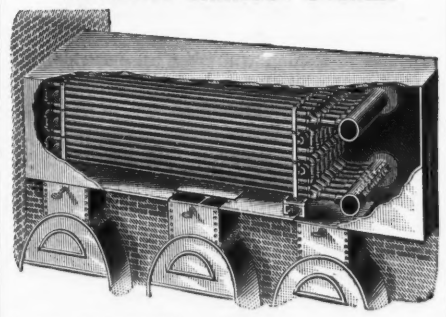
RE-HEATS EXHAUST STEAM.



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WITHOUT COST.

The Hussey Re-Heater and Steam Plant,

IMPROVEMENT CO.

A. S. Hatch, President.
S. D. Brewer, Gen'l Manager. 15 Cortlandt St., N. Y.

"Star" Foot Lathe Swings 9x25 in. | Screw Cutting Automatic Cross Feed, etc.

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Scroll Saws, Circular Saws, Lathes Mortisers. | Catalogue Free of all our Machinery

Seneca Falls Mfg. Co. 687 Water St., Seneca Falls, N.Y.

GEO. F. BLAKE MANF'G. CO.

BUILDERS OF EVERY VARIETY OF

95 & 97 LIBERTY ST., NEW YORK. 111 FEDERAL ST., BOSTON.

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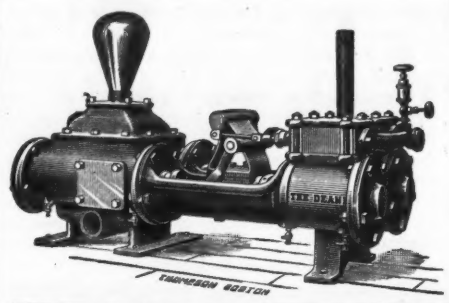

THE DEANE STEAM PUMP CO.,

HOLYOKE, MASS.,

New York, Boston, Chicago, Philadelphia, St. Louis,

Manufacturers of

STEAM and POWER

PUMPS

FOR ALL PURPOSES.

SEND FOR CATALOGUE.

MACHINE TOOLS ON HAND FOR IMMEDIATE DELIVERY.

15in., 24in. and 25in. Pillar Shapers. 15in. and 20in. Traverse Shapers. 10in., 16in. and 22in. Planers. 18in. x 6, 8, 10 or 12ft. Engine Lathes, (New Pattern.) 10, 12 and 15in. Speed Lathes. Larger size Planers at short notice. Also our Forming Lathe for special brass work. A few 2d hand tools also on hand.

THE HENDEY MACHINE CO.,

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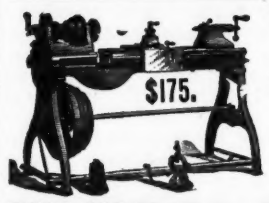
DRILL RODS.

The finest stock known for small taps, reamers, punches, jewelers' tools, watch and clock parts, &c. These rods work freely, harden without cracking at low heat, and are exact in size to micrometric measurement.

All regular sizes from .013" to 1½" diameter in 12" and 36" lengths. Other sizes to order.

MILLER, METCALF & PARKIN, CRESCENT STEEL WORKS,

CHICAGO, ILL. PITTSBURGH, PA. NEW YORK, N. Y.



Sebastian, May & Co.'s Improved Screw Cutting FOOT AND LATHES POWER

Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.

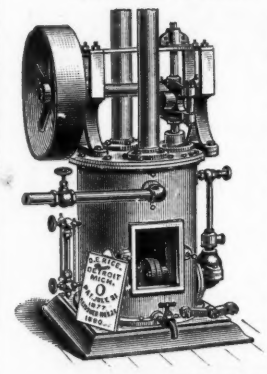
167 West Second Street, CINCINNATI, O.

OUR NEW 18 in. POWER ENGINE LATHE IS NOW READY

RICE'S PATENT

Feed-Water Heater and Purifier,

Combined with PUMP,



After 10 years' existence is still unequalled for durability, efficiency and economy. Manufacturers should carefully inquire whether their motive power is generated with all possible economy. Investigation costs but little time and will be very remunerative.

SEND FOR DESCRIPTIVE PAMPHLET.

Frank M. Clarkson, Detroit, Mich.

American Standard Gauge & Tool Works, Wilmington, Del.

Makers of Implements for Standard Measurements.

Over 34,800 in Use.

Flat Bar Gauge.

Crescent Gauge. JAS. A TAYLOR & CO.

FOR SALE. Victor Colliau No. 8 Improved Cupola. Having been delivered too late to set up for a special contract, we offer the above very cheap F. O. B. our works.

Dimensions as follows: Height over all, 32 feet. Drum, 84"x8'. Stock, 60"x19', 8". Tap spout, 5' from ground line; bottom of charging door to top of drum, 6', 5"; lines up 46" inside, to run 8 tons per hour.

Todd Pulley & Shafting Works,

East St. Louis, Ill.

COPELAND OIL-BURNING STEAM ENGINE

Water, Steam, Fire. Entirely and reliably AUTOMATIC. No engineer required. Consumes about one-third as much oil as other oil-burning engines. Weight of 2 H. P. engine, 100 pounds.

Northrop M'f'g Co.,

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EMERY WHEELS and GRINDING MACHINES

FOR SAW MILLS, FOUNDRIES AND MACHINE SHOPS.

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Or H. A. ROGERS, 19 John St., N. Y.

UNION STONE COMPANY,

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1½ in. Steel Arbor. Takes Emery or Corundum Wheels to 20" diameter. Of this style we have six sizes, to suit different classes of work, from ¾" to 2½ Arbor.

PATENT UNIVERSAL SCREW-CUTTING CENTER DEPTH ANGLE AND **TWIST DRILL GAUGE.**

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Fine Machinists' Tools.—E. Boston, Mass.—Send for Circular

—THE—

Binghampton Water Motor.

Simplest Motive Power Obtainable.

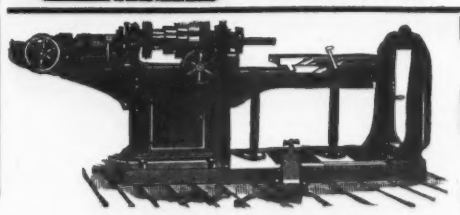
No Dirt. No Noise. No Engineer.

From 8 Horse-Power Down.

COOKE & CO.,

22 Cortlandt Street, New York.

Send for Price List, mentioning this paper.



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OF SUPERIOR QUALITY,

FOR USE IN

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Files and Rasps,

OF EVERY VARIETY, INCLUDING THEIR

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EXTRA X.F. FINE.
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FOR FINE TOOL MAKERS, JEWELERS, SILVERSMITHS, WATCHMAKERS, ETC.

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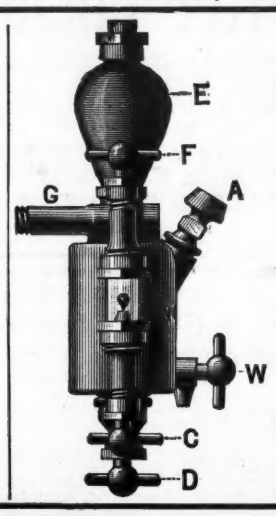

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UP-DROP, SIGHT FEED, LUBRICATOR,

(GATES PATENT.)

For Stationary Engines and Pumps of all kinds. Lubricators for Single or Double Connection.

PRICE LIST.

Nos.	1	2	3
Price	$10.00	$12.00	$15.00
Capacity	⅓ pt.	½ pt.	¾ pt.

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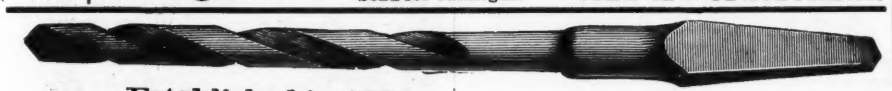
92 & 94 LIBERTY STREET, NEW YORK,

Send for Catalogue. SOLE MANUFACTURERS.



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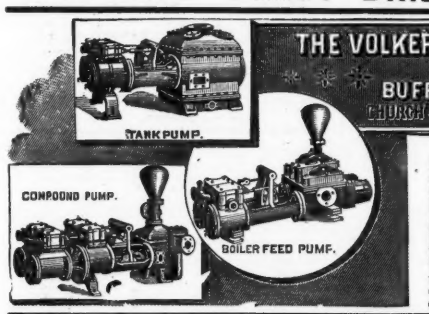

THE VOLKER & FELTHOUSEN M'F'G. CO.
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For Sale at Factory Prices by

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HALL STEAM PUMP CO.,

WHAT USERS THINK OF THE

We have been using your steam pump, and it has given us entire satisfaction, and don't desire anything better.
FORD, COX & CO., Fairmount, Md.

We feel that it is due you to say that we are using one of your steam duplex pumps for running or driving our oil presses, and with much satisfaction. If we had occasion for another pump, would order one just like it.
GULF CITY OIL MILLS. Mobile, Ala.

Duplex **Pump.**

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Force Blast Rotary Blower

FOR

FOUNDRIES, SMITH SHOPS, PNEUMATIC TUBES, VENTILATION, ETC.

SLOW SPEED.
POSITIVE BLAST,
PERFECTLY BALANCED.

Best Mechanical Construction.

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15 Astor Place, New York.

Mailed and Prepaid on Receipt of the Price.

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CENTRIFUGAL PUMP WORKS.
IRVIN VAN WIE, Prop.,
SYRACUSE, - N. Y.
VERTICAL,
Horizontal & Suction Pumps.
Capacity 100 to 40,000 gals. per minute.
Sand Pumping Outfits a Specialty.

Sterling Emery Wheel Co.,
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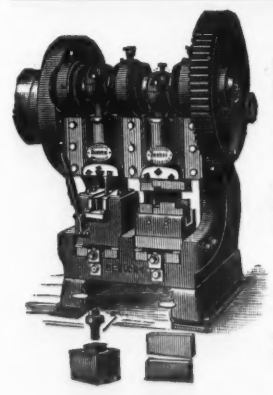
MANUFACTURERS,
23 Warren Street, New York.

Our Wheels for Machine Shop Work and Tool Grinding superior to all others.



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DUPLEX
Power Press
COMBINING
PRESS, SHEARS AND PUNCH.

BEAUDRY & CO.
(Formerly of Beaudry's Upright Power Hammer,)
Sole Manufacturers.
Also manufacturers of
HARD COAL HEATING FORGES.
Room 4, MASON B'DG,
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REDUCED PRICES OF LeCOUNT'S STRAIGHT TAIL DOG.

To be driven from a Stud in the Face Plate.

No.	INCH.	PRICE.	No.	INCH.	PRICE
1	¾	$0.60	10	2¼	$1.35
2	⅞	.70	11	2⅜	1.45
3	1	.70	12	3	1.60
4	1⅛	.80	13	3½	1.80
5	1¼	.80	14	4	2.10
6	1⅜	.95	15	4¼	2.75
7	1½	.95	16	5	3.25
8	1¾	1.10	17	5½	4.00
9	2	1 20	18	6	5 00
1 Set to 2 in.		7.80	Full Set		31.10

C. W. LeCOUNT, South Norwalk, Conn.

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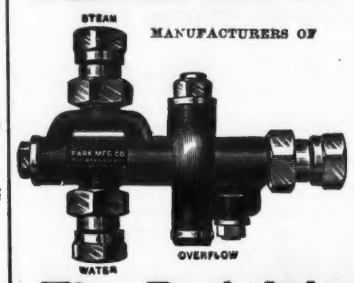

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EJECTORS AND JET APPARATUS.

MACHINE TOOLS.

Special or General, any size, for the manufacture of Ordnance, Locomotive, Marine and Stationary Engines, Ships' Boilers, &c., supplied to many leading Firms in the United States of America.

Asquith's Patent Radial Drills

Unequaled by any in the World. Send specification of requirements. Large Stock of Tools ready for delivery.

W. ASQUITH, HALIFAX, England.

DRILLING MACHINES.

ALL STYLES WITH
Latest Designs and Improvements.
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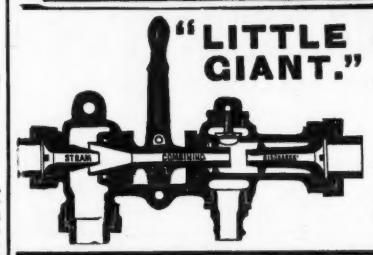

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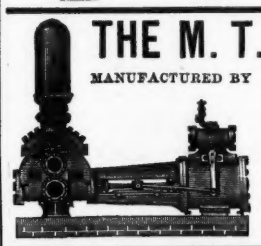

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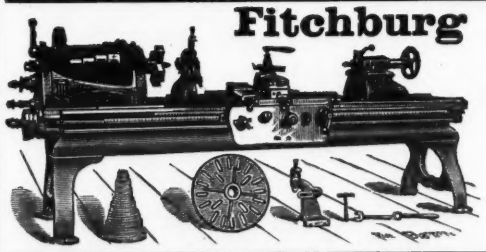

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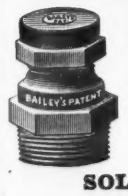

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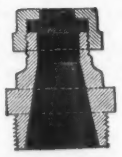

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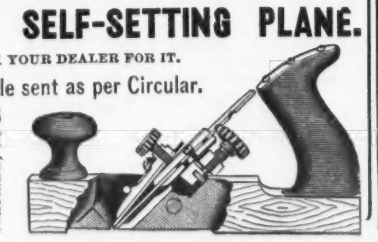

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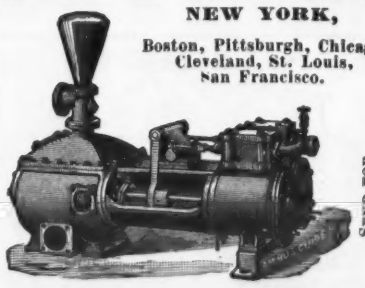

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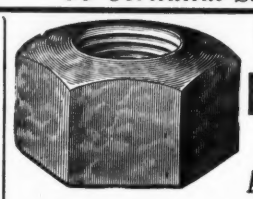

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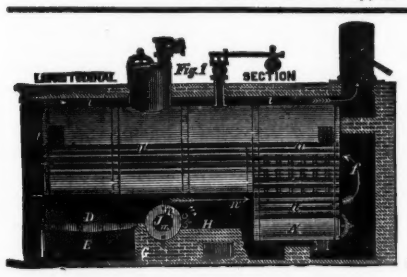

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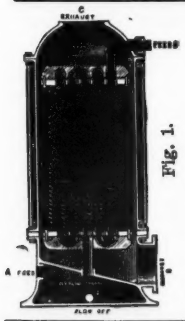

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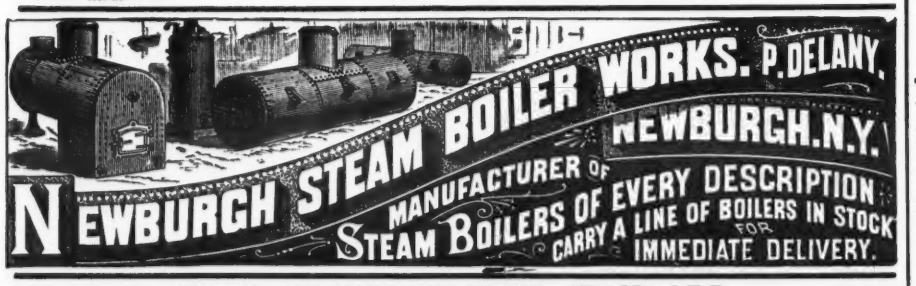
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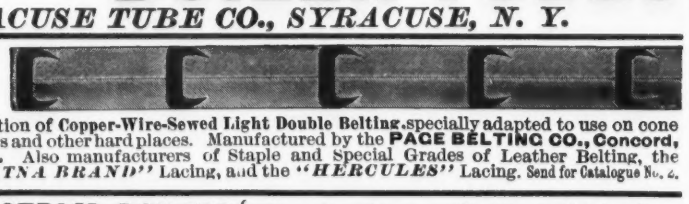

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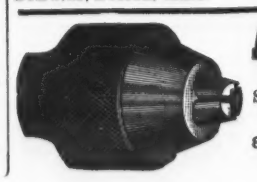

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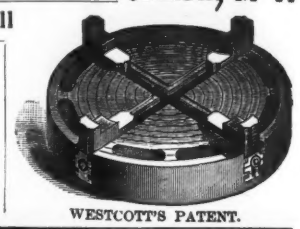

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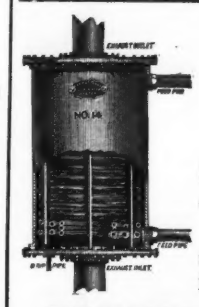

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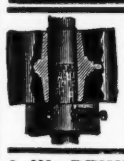

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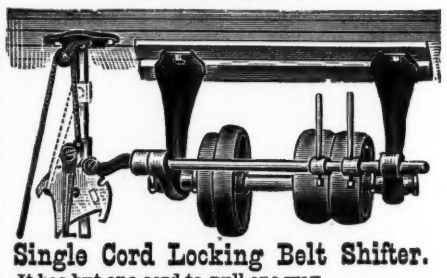

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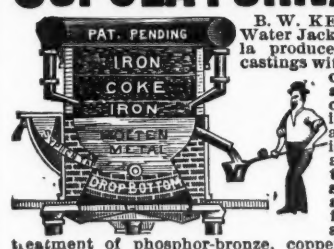

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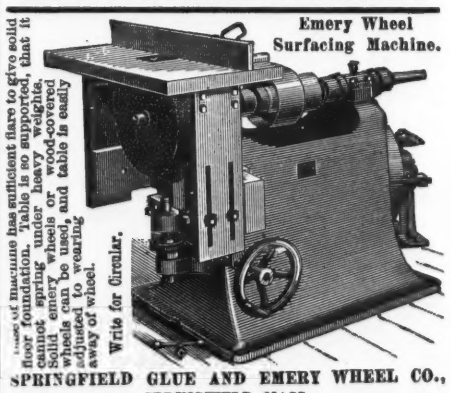

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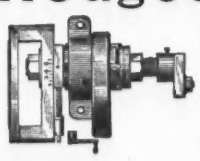

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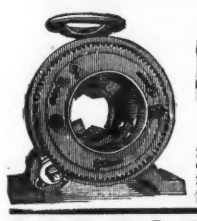

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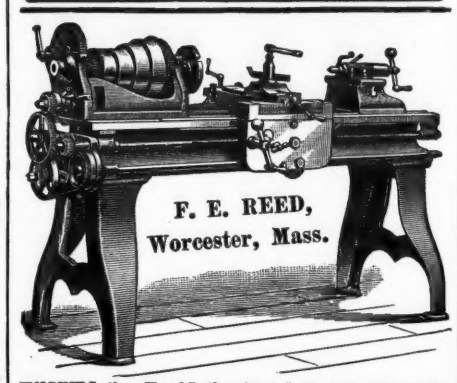

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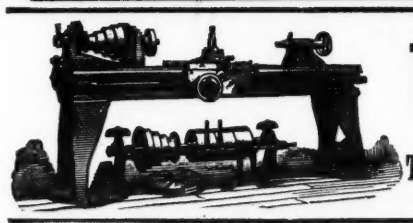

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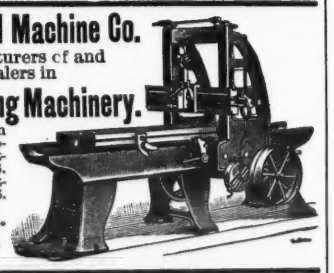

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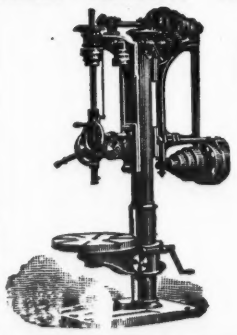

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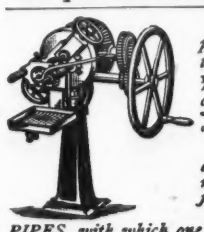

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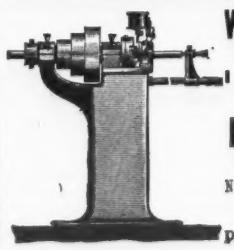

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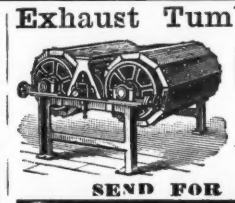

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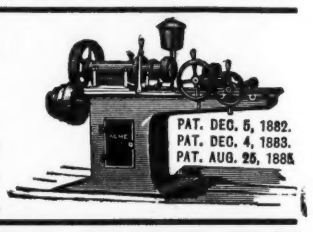

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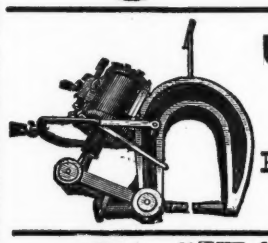

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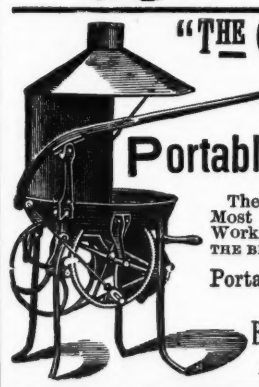

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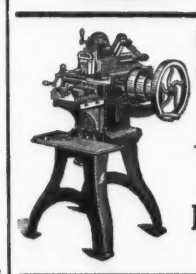

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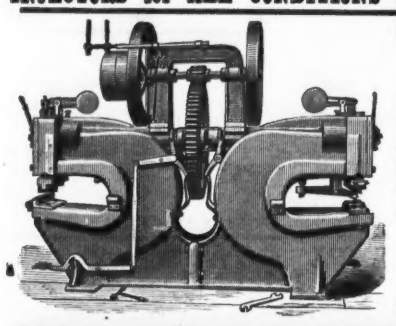

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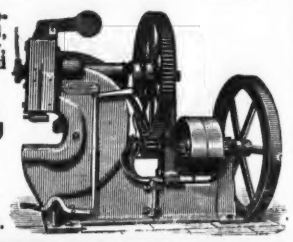

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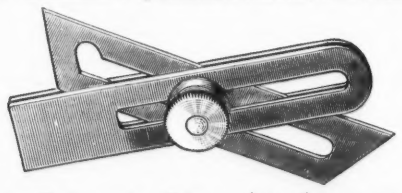

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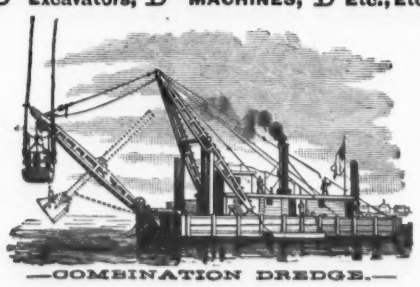

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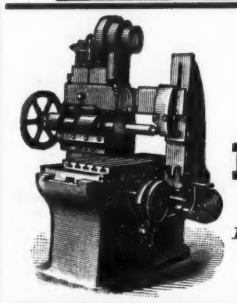

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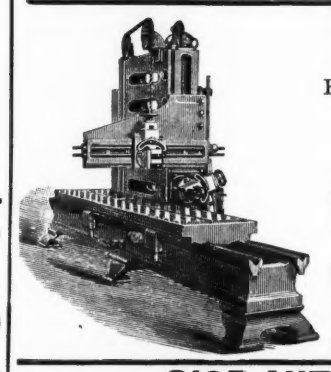

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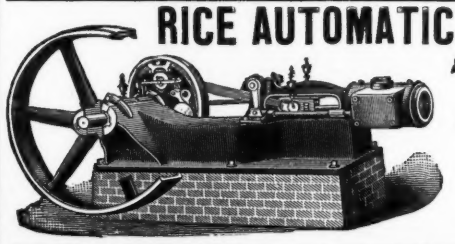

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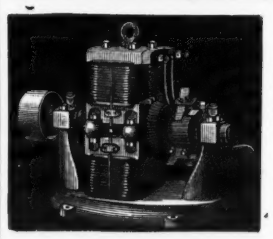

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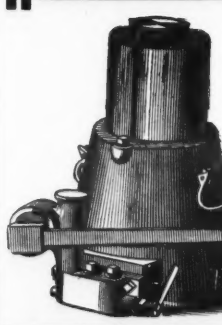

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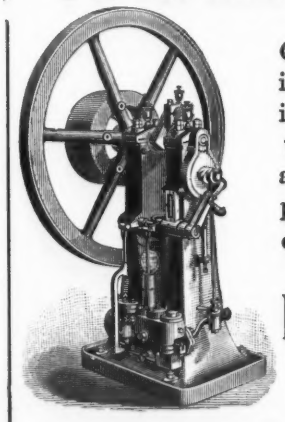

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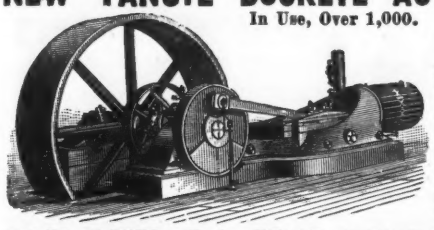

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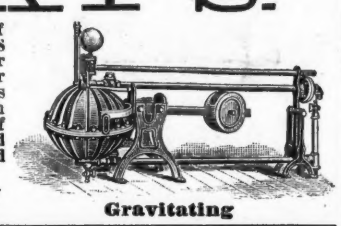

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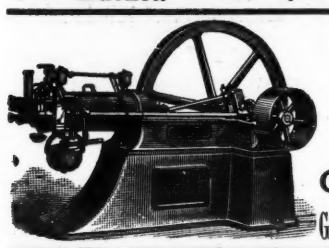

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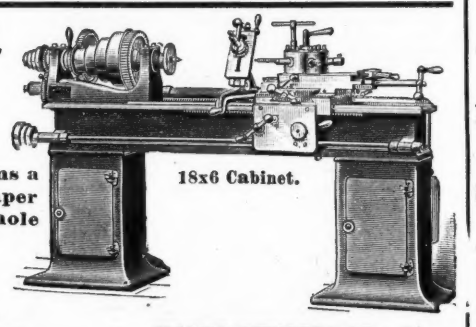

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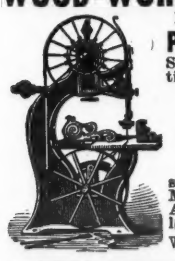

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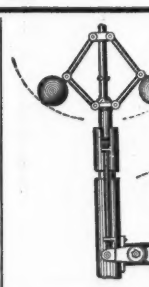

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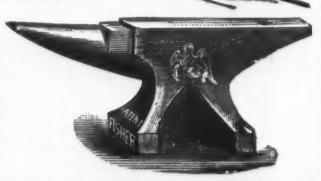

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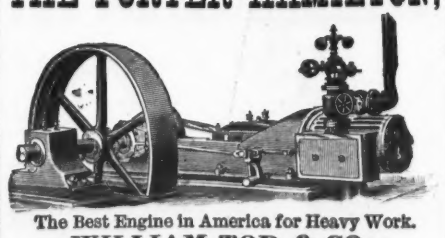

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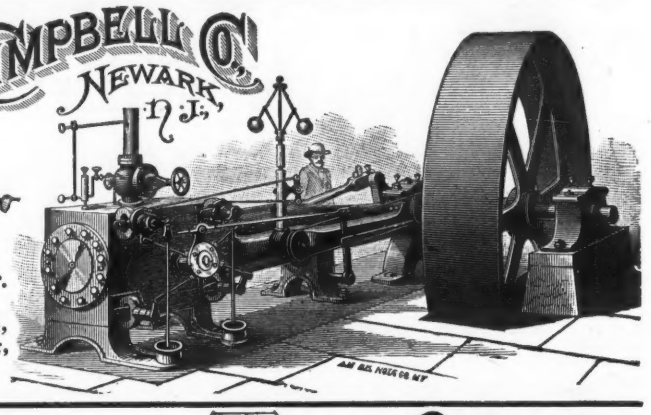

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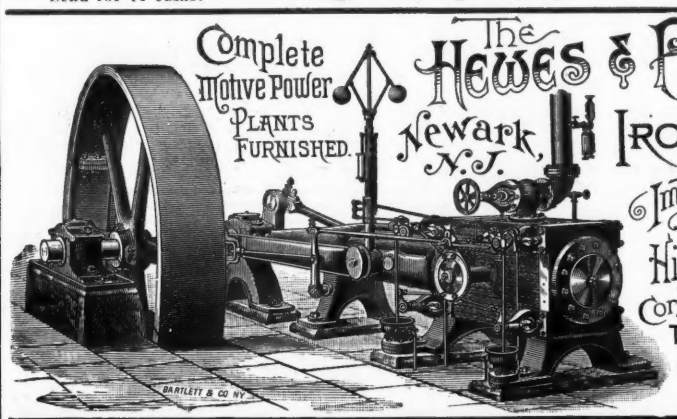

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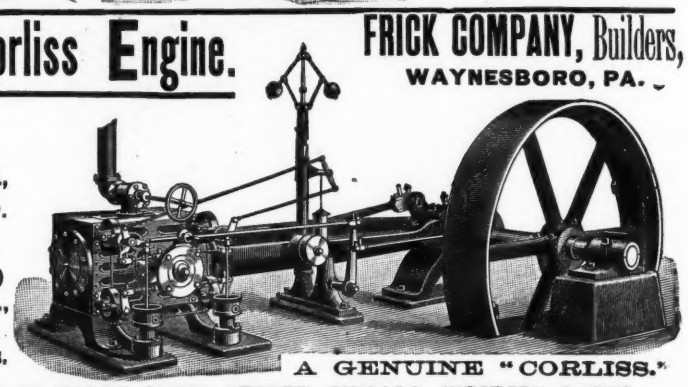

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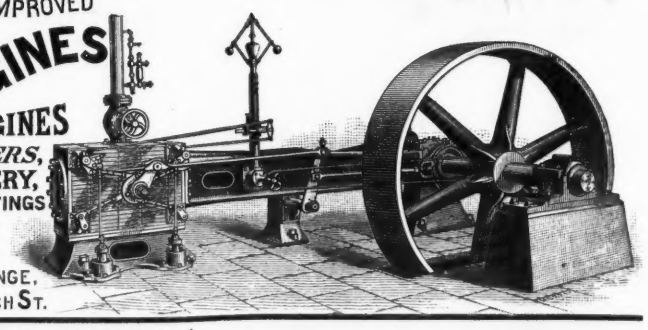

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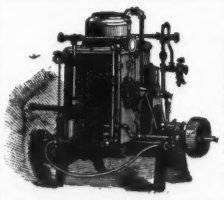

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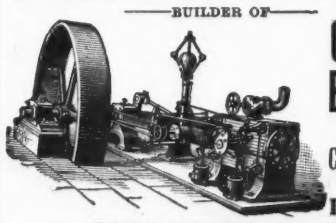

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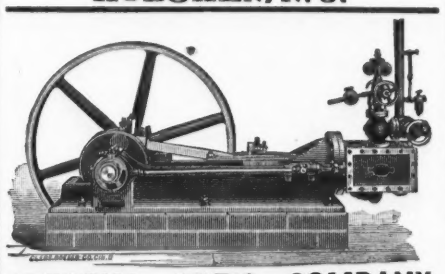

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List of Second-Hand Machines, taken in Exchange for New Tools.

36 in. Swing	12 ft.	Bed	Engine	Lathe,		Putnam.
33 " "	12 "	"	"	"		Portland Co.
18 " "	7 "	"	"	"		David W. Pond.
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Hendey Planer,	26" by 26"	by	6 ft.			
Newark "	36" " 36"	"	9 "			
Bement "	54" " 48"	"	12 "			
Eddy Gap Chucking Lathe,	48 in. swing,		8 ft. bed.			
Putnam "	" 60 "	"	9 "	"		
Monitor Brass Lathe, 18 in. swing, 5 ft. bed.						
Hendey Shaper, 18 in. stroke. Fine Condition.						
" " 24 "	"	"	"			
Wiley and Russell Bolt Cutter No. 5, cuts ⅝ to 1¼"						
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Brainard No. 7 Milling Machine with Vise.						
Car Wheel Borer, 48 in swing. Fine Condition.						
Pond Index Milling Machine.						
Brainard Gear Cutter, 30 in. Automatic Feed.						
" " " 18 "	"	"				
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" " 4 "	"	4 "				
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The machine shops are fire-proof. The business, accordingly, is free from danger of serious interruption, and, on work entrusted to us, our customers are given security against loss from fire.

Our tools and appliances are the best attainable, and, with the buildings, afford unusual facilities for economical manufacture. The machines and tools described in this catalogue are made with the intention that they shall be the best of their respective classes. Careful attention is constantly given to insure workmanship of the best quality. Cylindrical bearings are accurately ground; plain bearings are scraped to surface plates; alignments are correct.

All machinery is subjected to inspection, in detail, and, when deemed requisite, to actual operation, before being packed. * * * *

We are prepared to manufacture special machines, parts of machines, and a large range of articles in the line of fine machine work; and, in this way we are frequently of assistance to those who control certain articles, or lines of machinery, but do not themselves wish to engage in manufacturing. * * * * *

Care should be taken to destroy old catalogues. Only those of the latest edition should be kept on hand. * * * *

A comparison of Price Lists in this and previous catalogues will show that the prices of most of our cutters and small tools have been reduced. The prices of many machines have also been reduced.

Special pamphlets or circulars, describing the construction and use of various machines, are furnished on application.

The machines and tools described in catalogue are usually kept in stock. * * * *

As most of our machines are the outgrowth of our own wants in manufacturing, their capacity, and the nature of the work they perform, can, perhaps, be best appreciated by a visit to our works. We are always ready and glad to show our works to those who contemplate purchasing machinery or are interested in machine shop or foundry practice. Catalogues sent by mail on application.

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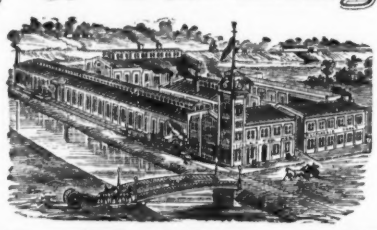

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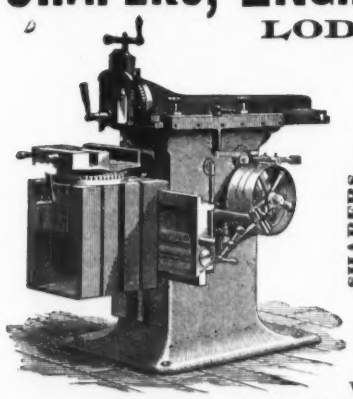

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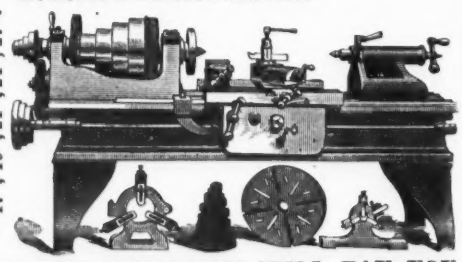

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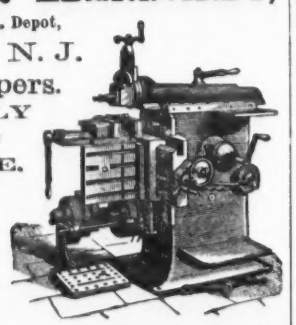

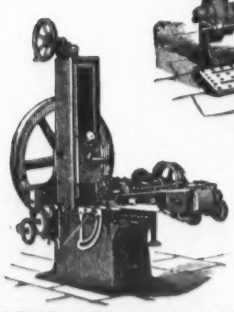

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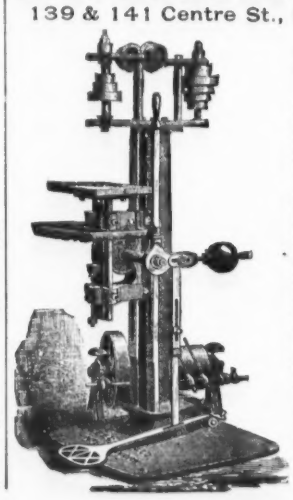

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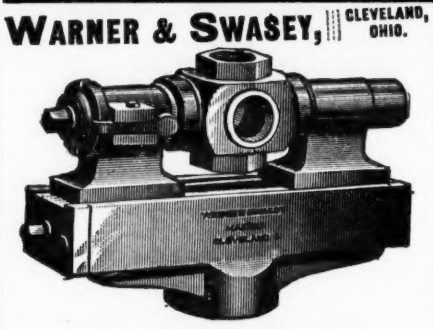

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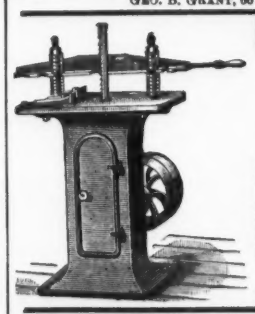

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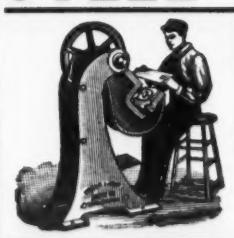

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